Why the Sciences of the Ancient World Matter 4

Robert Middeke-Conlin

The Making of a Scribe

Errors, Mistakes and Rounding Numbers in the Old Babylonian Kingdom of Larsa

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Why the Sciences of the Ancient World Matter

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To all my teachers,
past, present and future

Acknowledgements

The impetus for this book[1] came while I pursued my master's degree, when I found myself unable to explain discrepancies in some texts. I wondered whether there might be some reason behind these discrepancies. At the time I could do little other than note the discrepancies and move on in my research. I was training in Assyriology, fascinated by ancient industries and economics and certainly not a historian of mathematics. It would not be until 2011, when the project Mathematical Sciences in the Ancient World (SAW), headed by Karine Chemla and co-directed by Agathe Keller and Christine Proust, put out a call for pre- and post-doctoral fellowships. This project, which was funded by a grant from the European Research Council, had as one of its axes of research state finance administrations and a focus on mathematics in Mesopotamia. The project I imagined focused on rounding numbers as a means to address discrepancies in these texts, in particular, rounding in connection with errors and mistakes. I wanted to explore whether the Old Babylonian scribes intentionally produced deviant values. With the support of my generous wife, I applied for this grant. She has always been my biggest supporter, during and since my Ph.D. work. I owe everything to her.

My project was accepted, and in November 2011 I travelled to Paris to work as a member of the SAW project under the direction of Christine Proust, my advisor. I was quickly counseled to take on a co-advisor, Cécile Michel—I readily agreed. Both were instrumental in guiding my work. I owe much to them. Any fault in this work is my own, any success is truly theirs.

The academic environment fostered by the SAW Project was quite remarkable. In addition to Assyriologists, I worked with Sinologists such as the project's head Karine Chemla, Indologists such as one of the co-directors, Agathe Keller, scholars of Medieval Islamic thought and mathematics, ancient Greek astronomy, modern

[1]The dissertation leading to this work was submitted as part of the SAW project and was made possible through funding from the European Research Council under the European Union's Seventh Framework Program (FP7/2007–2013)/ERC Grant agreement no. 269804. Research since then has been carried out under a fellowship from the Berlin Center for the History of Knowledge, through the Max Planck Institute for the History of Science.

researchers focusing on textual analysis and many others. This interdisciplinary approach to scholarship offered insights into research that necessarily guides my work even if it can be difficult to recognize exactly how.

This work required travel; each available tablet needed collation to witness that a discrepancy was the result of an ancient scribe's work and not a modern mistake, misrepresentation, misinterpretation, etc. In this regard, I would like to thank Christine Desse, the secretary of the Department of Antiquities at the Louvre, Nora Belkebla, the assistant secretary who allowed me to visit and view tablets at the Louvre and especially Norbeil Aouici, the artwork registrar who accompanied me through the Louvre and prepared tablets for my inspection. Thanks are also owed to Dr. Paul Collins, curator of the Ashmolean Museum's Ancient Near East collection, who allowed me access to the collection and even sat with me while I worked with and viewed texts from the Ashmolean Museum. At Leiden University, I would like especially to thank Drs. T. J. H. Krispijn, docent of the de Liagre Bohl collection, who kindly allowed me access to the collection and even took me to lunch. Finally, at Yale's Babylonian Collection where I visited several times, I must thank Prof. Benjamin Foster, curator of the collection, for granting me access to the texts and the rights to publish several texts. In addition, Ulla Kasten, the former associate curator and Dr. Elizabeth Payne, the collection's conservator at the time, as well as Dr. Agnete Lassen, the current associate curator, deserve my gratitude. They prepared tablets for my use and answered my questions. My work could not have been completed without my visits to these collections. These individuals and the institutions they work with were vital to the successful completion of this volume.

I defended my dissertation in June 2015, but following general advice given to me by Prof. Benjamin Foster years ago (before I even began pursuing my Ph.D.), I delayed publishing this work after defending. As he says, it is better to let things sit for a while and then return with fresh eyes and new evidence. In this publish-or-perish academic world, that may seem a bit anachronistic. However, I do believe this advice to be prudent. Problems were solved between my original dissertation and this renewed work. Several important texts have come to light, such as YBC 12273 presented in Chap. 8. The book is far better than it would have been had I rushed to publish. For this reason, I finally completed this book at the Max Planck Institute for the History of Science and I am deeply grateful to this institution for affording me the time to finish this work as the beginning of a new project on scribal numeracy. This book must be credited to many individuals who guided me in my work, allowed me access to vital resources, assisted me along my way and gave judicious advice when needed. Thank you to all who were there to help and guide me.

Robert Middeke-Conlin

Contents

1 Introduction 1
- 1.1 The Book Structure and Technical Notes 3
- 1.2 An Overview of the Kingdom of Larsa, Past and Present 7
  - 1.2.1 The Trouble with Chronology 8
  - 1.2.2 The City of Larsa, Its Environs and Modern Archaeology 9
- 1.3 Current Trends in Assyriology 10
  - 1.3.1 Archival Studies 10
  - 1.3.2 Unity Out of Variety 12
  - 1.3.3 Archives and the Parameters of Study 16
- 1.4 Mistakes and Errors—Preliminary Remarks 16

2 The Early Scribal Education 21
- 2.1 Systems of Quantification 22
  - 2.1.1 Measurement Systems 23
  - 2.1.2 Bridges and Other Connections Between Metrological Systems 27
  - 2.1.3 Numerical Systems 28
- 2.2 Elementary Education in the Old Babylonian Period 34
  - 2.2.1 Tablet Types 35
  - 2.2.2 Metrological Lists and Tables in the Scribal Curriculum 41
  - 2.2.3 Numerical Tables and Elementary Education 52
- 2.3 Conclusions 57

3 Text Types and Archival Practices in the Kingdom of Larsa 59
- 3.1 Text Layout and Structure 62
  - 3.1.1 Tabular and Prosaic Layout 62
  - 3.1.2 Single Transactions 65

3.1.3 Lists 67
3.1.4 Balanced Accounts 74
3.2 Conclusions 79

4 Archives, Bureaus and Management Systems in the Kingdom of Larsa 81
4.1 The Grain Storage Bureau 84
4.2 The Bureau of Irrigation and Excavation 92
4.3 Grain Harvest Archive 97
4.4 Grain Production Archive(s) 97
4.5 Conclusions 98

5 Metrology and Sexagesimal Place Value Notation in Economic Texts 101
5.1 The Transparency of Economic Texts 103
5.2 Possible Sexagesimal Place Value Notation Basis for Calculations 107
5.3 Explicit Statements of Sexagesimal Place Value Notation 114
5.4 Conclusions 117

6 Errors, Mistakes and Evidence for a Counting Device 121
6.1 The Nature of Discrepancies 123
6.2 An Abacus? 125
6.2.1 Carrying in Other Texts 126
6.2.2 Evidence for Addition in Mathematical Texts 128
6.2.3 Abacus and Administrative Practice 130
6.3 Conclusions 134

7 Observation and the Limits of Numeracy 139
7.1 Breakdown of Trust and the Practice of Oversight 141
7.1.1 The Uniformity of Measurements and Measurement Values 143
7.1.2 Standard Variation 144
7.1.3 Changing Standards and Value Assessments 150
7.2 Measurement Inconsistency and Grain Transit 155
7.3 Production and Conception of Value 162
7.3.1 Below the Lower Limit: The Expert 164
7.3.2 Below the Lower Limit: The Novice 168
7.4 On Measurement Theory and Practice 169
7.5 Conclusions 171

8 Multiplication and Estimation 177
8.1 Revenue Rates 178
8.2 Equivalencies 185

8.2.1 Do Equivalencies Reflect a Calculation? 186
8.2.2 Equivalencies in the Mathematical Tradition 189
8.2.3 Equivalencies and Discrepancies 191
8.3 Estimation, Observation and Labor 199
8.3.1 Volume, Labor and Wages in Economic Texts 200
8.3.2 Volume, Labor and Wages in the Mathematical Tradition 201
8.3.3 Sexagesimal Place Value Notation, Volume and Labor 204
8.3.4 Sexagesimal Place Value Notation, Volume and Scribal Practice 208
8.3.5 Volume as an Observation of Labor 211
8.3.6 Labor as a Statement of Wages 215
8.4 Tabular Layout and Economization of Practice 221
8.5 Conclusions 224

9 Rounding in Mathematical and Economic Texts 229
9.1 Truncation of Measured and Calculated Values in Administrative Texts 234
9.2 Other Examples of Rounding Down in the Economic Texts 236
9.3 Rounding up in the Economic Texts 238
9.4 Rounding and Multiplication 241
9.5 Rate Approximations and the Uncertainty of Interpretation 242
9.6 Conclusions 245

10 Conclusion: On Errors, Rounding and Education in the Kingdom of Larsa 249

Appendix 1: Texts 259

Appendix 2: Numeracy by Scribe 349

Appendix 3: Metrological and Numerical List and Table Catalogue . . . 391

Appendix 4: Price and Wage Index and Charts 407

Appendix 5: Discrepancy Index 427

Bibliography 441

Indexes to the Text Editions 453
Part I Akkadian and Sumerian Word Index 455
Part II Name Index 469
Part III Economic Text Index 475
Part IV Mathematical Text Index 479

Subject Index 481

Abbreviations

This list is largely populated by museum and collection numbers. However, three works are so ubiquitous under their glosses that, while it may seem odd to the outsider, it would have led to greater confusion if they were listed under any other name but their abbreviation: the CAD produced by the Oriental Institute of the University of Chicago, the ePSD produced by the Babylonian section of the University of Pennsylvania and finally, the VIM published by the Joint Committee for Guides in Metrology. In addition, some works, such as the Ur Excavation Texts, are best referred to by their publication number and not museum number because these are not always available.

AO	Museum siglum, Louvre, Antiquités orientales, Paris
Ashm	Museum siglum, Ashmolean Museum, Oxford
AUAM	Tablets in the collection of the Andrews University Archaeological Museum
BM	Museum siglum of the British Museum, London
CAD	The Assyrian Dictionary of the Oriental Institute of the University of Chicago https://oi.uchicago.edu/research/publications/assyrian-dictionary-oriental-institute-university-chicago-cad
CAM	Tablets from the collection of the Cincinnati Art Museum, Cincinnati
CBS	Museum siglum of the University Museum in Philadelphia
CDLI	Cuneiform Digital Library Initiative (https://cdli.ucla.edu/)
ePSD	Electronic Pennsylvania Sumerian Dictionary, Babylonian Section, University of Pennsylvania Museum of Anthropology and Archaeology http://psd.museum.upenn.edu/epsd1/index.html
Erm	Museum siglum, State Hermitage Museum, St. Petersburg
HE	Tablets from the collection of the École Pratique des Hautes Études, Paris
HS	Tablet siglum of the Hilprecht Collection, Jena
IM	Museum siglum of the Iraq Museum, Baghdad
LB	Tablets in the Liagre Bohl Collection, Leiden

M	Collection siglum, John F. Lewis Collection, Free Library of Philadelphia
MAH	Museum siglum, Musée d'Art et d'Histoire, Geneva
MHC	Tablets from the collection of the Mount Holyoke College
MLC	Collection siglum, Morgan Library Collection, Yale Babylonian Collection, New Haven
MS	Collection siglum, Martin Schøyen Collection, Oslo
N	Museum siglum, University Museum, Philadelphia
N-T	Field numbers of tablets excavated at Nippur, in Chicago and Baghdad
NBC	Museum siglum, Nies Babylonian Collection
NI	Museum siglum, Archaeological Museum, Istanbul
PTS	Tablet siglum, Princeton Theological Seminary, Princeton
UET 5	Figulla and Martin 1953
UET 6/2	Gadd and Kramer 1966
UET 7	Gurney 1974
UM	Tablet siglum, University Museum, Philadelphia
VAT	Museum siglum, Vorderasiatisches Museum, Berlin
VIM	Joint Committee for Guides in Metrology. 2012 International Vocabulary of Metrology—Basic and General Concepts and Associated Terms, 3rd edition
YBC	Museum siglum, Yale Babylonian Collection

Glosses for Assyriology

Publication glosses are added here for the benefit of the Assyriologist who may be familiar with each text, but under its publication gloss rather than its museum number.

Alexander 1943: BIN 07
Dalley 2005: OECT 15
Dossin 1933: TCL 17
Dossin 1934: TCL 18
Grice 1919: YOS 5
Faust 1941: YOS 8
Feigin 1979: YOS 12
Jean 1926: TCL 10
Klengel 1973: VAS 18
Leemans 1964: TLB 1
Neugebauer 1935-1937: MKT I-III
Neugebauer and Sachs 1945: MCT
Riftin 1937: SVD or SVJAD
Sigrist 1990: AUCT 4
Simmons 1978: YOS 14
Thureau-Dangin 1938: TMB
Von Soden 1985: AHw
Walters 1970: YNER 4

List of Figures

Fig. 8.1 Canal dredging project, YBC 12273, lines 2–3 (not to scale). 206
Fig. 8.2 Canal dredging project, YBC 12273, lines 5 and 6 (not to scale). 207

List of Tables

Table 1.1 Rulers of Larsa. 8
Table 2.1 Examples of texts with capacity measurement values. 24
Table 2.2 Examples of texts with weight measurement values 25
Table 2.3 Examples of texts with area or volume measurement values 26
Table 2.4 Comparison of normalized and non-normalized numbers 29
Table 2.5 Measurement units and associated whole numbers 30
Table 2.6 Fraction signs 30
Table 2.7 Courses 1 and 2 at Larsa 36
Table 2.8 Type III tablets by course at Larsa. 38
Table 2.9 Comparison of HS 235 (left), and Ashm 1923-410 (right). . . . 43
Table 2.10 Measurement values and cycle shifts from Nippur 45
Table 2.11 Capacity compared between scribal centers 47
Table 2.12 Weight compared between scribal centers 47
Table 2.13 Area and volume compared between scribal centers. 48
Table 2.14 Length compared between scribal centers. 48
Table 2.15 Height compared between scribal centers 49
Table 2.16 Numerical tables by provenance. 54
Table 2.17 Reciprocal tables and head number alignment (in translation) 56
Table 3.1 Formal tables 63
Table 3.2 Tabular lists 64
Table 3.3 Single transactions 65
Table 3.4 Simple lists. 71
Table 3.5 Silver lists and grain lists 71
Table 3.6 Silver delivery lists. 73
Table 3.7 Silver recipient lists 74
Table 3.8 Silver balanced accounts 75
Table 3.9 Grain balanced accounts. 75
Table 3.10 Grain shipment texts 76

Table 4.1 Texts and actors in the grain storage bureau 85
Table 4.2 Bureau during the reigns of *Rīm-Sîn* and *Hammu-rābi*. 94
Table 5.1 Calculation for YBC 06216, expected total and actual total 104
Table 5.2 Possible equivalency calculation for AUAM 73.2672 104
Table 5.3 Four texts with unstated but implied totals. 105
Table 5.4 Comparison of calculations between LB 1074 and LB 1078 106
Table 5.5 The Old Babylonian reciprocal table 108
Table 5.6 Mentioned equivalency rate accounts 109
Table 5.7 Texts that mention wage rates 110
Table 5.8 Comparison of rate between AO 08464 and AO 08463. 112
Table 5.9 Reciprocal pairs suggested in AO 08464 113
Table 5.10 Documents with partial-sexagesimal place value notation 115
Table 5.11 Documents with sexagesimal place value notation in calculations 116
Table 6.1 Addition of sesame values in YBC 04224 122
Table 6.2 Addition of silver values in YBC 04224 123
Table 6.3 Subtraction in YBC 04224. 125
Table 6.4 Addition and expected addition in YBC 04224: 35–52 125
Table 6.5 Addition and expected addition in YBC 04224: 35–52 126
Table 6.6 Additions by *gin* and fraction of *mana* measurement values in YBC 04224. 126
Table 6.7 Additions of the number of *mana* in YBC 04224 127
Table 6.8 Calculation by addition in LB 1074. 127
Table 6.9 Stated and expected addition in LB 1074. 128
Table 6.10 Partial-sexagesimal place value notation for capacity system 131
Table 6.11 Addition of grain in column 7 of Ashm 1923-340. 132
Table 6.12 Addition of grain in column 3 of Ashm 1923-340. 133
Table 6.13 Addition in two parts for Ashm 1922-277 135
Table 6.14 Addition in two parts for Ashm 1923-340 135
Table 6.15 Potential layout of counting device for weight. 136
Table 6.16 Addition in two parts as shown in YBC 04224 137
Table 7.1 Capacity measures in YBC 04669 by problem. 144
Table 7.2 Capacity standard vessels by archive 146
Table 7.3 Syrian weights in grave LG/23. 148
Table 7.4 Mesopotamian weights in grave LG/45 149
Table 7.5 Proposed standard conversion calculation in YBC 04265. 153
Table 7.6 Calculation by addition/subtraction in YBC 06231 158
Table 7.7 Measurement error in the grain storage bureau. 159

Table 7.8 Truncation and error in the grain storage bureau 160
Table 7.9 Fractions in YBC 04607, problems 1–5 165
Table 7.10 Construction of fractions in YBC 04607, problems 1–5 167
Table 7.11 Transformation of fractional construction in YBC 04607, problems 1–5 167
Table 7.12 Fractions in type IV tablets from Nippur 169
Table 8.1 Texts showing equivalency rates 186
Table 8.2 Interpretation of MS 2830 § 2a 190
Table 8.3 Equivalency in YBC 07744 lines 7–8 191
Table 8.4 Equivalency in AO 06760, lines 18–19 192
Table 8.5 Equivalency in YBC 04224, lines 26–27 193
Table 8.6 Equivalency of expected total sesame values in YBC 04224, lines 26–27. 193
Table 8.7 Equivalency in NBC 08014, lines 1–3 194
Table 8.8 Equivalency in YBC 07473, lines 13–14 196
Table 8.9 Equivalency calculations for YBC 07473, lines 1–11. 198
Table 8.10 Differences between stated and expected volume in NBC 06763. 202
Table 8.11 UET 6/2 233 interpretation. 203
Table 8.12 Calculation in YBC 04663, problem 1 203
Table 8.13 Addition in YBC 12273. 205
Table 8.14 Expected calculation of columns 1–3 in YBC 12273 205
Table 8.15 Calculation of columns 1–3 in YBC 12273 206
Table 8.16 Calculation of labor in YBC 12273 207
Table 8.17 Calculation in BM 085238. 210
Table 8.18 Calculation for problem 7 of YBC 04663 213
Table 8.19 Stated and proposed addition in NBC 06763 214
Table 8.20 Differences between stated and expected volume in Ashm 1922-290 215
Table 8.21 Wage calculation in Riftin 1937: no. 116. 217
Table 8.22 Wage calculation in Ashm 1922-281 218
Table 8.23 Summary of wage calculations in LB 1074 219
Table 8.24 Wage rate calculation in Ashm 1923-315. 220
Table 8.25 Wage rate calculation in AO 08461 220
Table 8.26 Hypothetical tabular layout to calculate VAT 08521, problem 1. 223
Table 9.1 YBC 04698, statement 14, proposed solution. 232
Table 9.2 Truncation and difference of added values 235
Table 9.3 Rounding to lower value after addition or subtraction 236
Table 9.4 Values rounded down in sexagesimal place value notation . . . 237

Table 9.5 Texts dealing with volume or brickage in the *Lu-igisa* archive . . . 238
Table 9.6 Rounding to higher value after addition or subtraction . . . 239
Table 9.7 Rounding in, or as a result of, multiplication . . . 241
Table 9.8 Computed field size and expected field sizes for LB 1097 . . . 243

Chapter 1
Introduction

Abstract This introductory chapter provides a synopsis of the present volume and lays the groundwork for the study of errors, mistakes and rounding numbers. The book structure is described, an overview of the kingdom of Larsa is presented, including issues with chronology and provenance, methodology is outlined and then a brief introduction to discrepancies, errors and mistakes is laid out. Mistakes are understood as unintentional discrepancies that result from a scribe's own lapse in judgement or understanding. A mistake is avoidable, but the scribe is unaware of its existence. On the other hand, it is hypothesized that some errors were intentional, or at least that the scribe was aware of potential deviations between his assertion and a truth. Error would then be unavoidable, but the scribe is aware of its (potential) existence. This hypothesis is pursued throughout this volume where observational and conceptual errors, as well as rounding numbers as a kind of error, are explored.

How do we cope with error and mistake in texts? This is an essential question in Assyriology, a discipline defined by an almost overwhelming abundance of sources, the majority of which are economic in nature. Another question can be asked as well: How is error to be defined? Error, mistake and the potential for both are often a source of difficulty for the Assyriologist who, when a discrepancy is noticed in a text, must attempt to explain it. This is expressed by Van de Mieroop (1999: 125) concerning discrepancies in texts from the ancient city of Umma:

> Although any scholar who has added and subtracted numbers in such accounts, even with the help of a calculator, may sympathize with the Sumerian scribe's mistakes, these discrepancies create a sense of exasperation, as we do not know exactly what to believe.

Discrepancies in texts do appear and, while they may be exasperating at times, they must be explained in a way that incorporates the ancient Mesopotamian scribe's

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of the Ancient World Matter 4, https://doi.org/10.1007/978-3-030-35951-5_1

own culture. The economic texts[1] were produced by a scribe who was the product of an education and who carried out operations and procedures learned in the course of his education, whether this education was a scribal school, an apprenticeship or something else. A problem faced by the Assyriologist when assessing this environment is that the economic texts often give the appearance of lists, stating only desired information and leaving little trace of operations and procedures used by the scribe to construct his texts. Thus, the impact that the scribal education, for which there is a remarkable amount of evidence from the Old Babylonian period, had on the scribes themselves is often difficult to envisage.

Traces of these operations and procedures do, however, exist. The very discrepancies that pose a conundrum for modern scholars might also afford evidence for mathematical operations in the economic texts. If there is an error in a text, then there are traces of how the text was produced. If this error occurs in a calculation, then we, the modern observers, can begin to piece together how the text's author carried out his calculation. Error offers insight into how an ancient scribe understood his system of quantification, how he manipulated this system and how he exploited this system in everyday life. The environment which fostered the scribal art can be better understood by looking at error in economic texts in light of the scribal curriculum.

Error, here, is not simply a mistake. In fact, error is differentiated here from a mistake. An error is intentional, or at least the scribe is aware of its potential. Error results from the scribe's own computational culture acting on him to produce an acceptable discrepancy between what is expected and what is stated in the text. On the other hand, a mistake is unintentional, the result of the scribe's own inattentiveness, although this lack of attention may be the result of surroundings as well. The present work seeks to explore this distinction by situating error in the computational culture which fostered it. Rounding numbers is used to enter into this discussion, but in order to explore how rounding numbers was expressed in the scribal education and adapted for administrative purposes, the present work must explore error in its entirety, distinguishing error from mistake.

To help in this discussion, this work isolates how error appeared and was dealt with, as well as how rounding numbers was practiced in a particular culture. The purpose of this work is to discuss how and why rounding numbers was carried out in the kingdom of Larsa, a kingdom that flourished in the early Old Babylonian period, that is, the beginning of the second millennium BCE. This period and place are chosen because of the breadth of economic sources as well as the numerous mathematical texts derived from an educational context. This combination of economic and mathematical texts affords a unique glimpse into how mathematical processes were presented and learned in educational environments as well as how

[1]An 'economic text' is understood broadly as any text produced to assist the management of a complex economy and follows the definition of 'economic' provided by Merriam-Webster, 'of, relating to, or based on the production, distribution, and consumption of goods and services'. Merriam-Webster, https://www.merriam-webster.com/dictionary/economic. Accessed 25 October 2018.

accounting was practiced in professional settings. By examining texts of this period, it is hoped to facilitate the exploration of rounding numbers as it was expressed in the scribal curriculum and adapted for administrative purposes.

Most of the economic texts discussed here present one or several errors, mistakes or examples of rounding in some form. Some texts clarify the use of numbers in the texts themselves, even if no example of rounding, error or mistake can be detected. This is especially evident for Ashm 1924-453, an unprovenanced and undated list which describes two days of activity and which will be explored more in Chap. 5. Some texts when taken in isolation offer little evidence of the mathematics involved in their production. However, as a group they reveal much about the mathematics incorporated in their production and the purpose of rounding in this environment. This is particularly evident for the texts belonging to the grain storage bureau, which are discussed in Chap. 7. Thus, all texts presented or discussed here help to understand error and rounding numbers, as well as the mathematics behind these processes, in the various economic environments.

1.1 The Book Structure and Technical Notes

The work here is divided into two main parts, an introductory part and the main discussion. The first part introduces this volume and provides a framework for the texts studied here. This introductory chapter outlines a brief description of the kingdom of Larsa and then describes the methodology used in this study. These initial remarks help to set up discussion by providing the context of the ancient texts as well, modern scholarship and then preliminary comments on error and mistakes. Chap. 2 begins this work by entering into a discussion of numbers and metrology as well as a brief outline of Old Babylonian mathematical education. Appendix 3 presents a catalogue of metrological list and tables as well as numerical tables studied and exploited in the chapter. Chap. 3, a textual discussion, describes the texts themselves and the archives in which they were produced. This discussion helps to understand how texts are used and how they generally relate to each other. The texts themselves are presented in Appendix 1. Chap. 4 will present a study of the scribes and bureaus that define the texts. It is supplemented by Appendix 2, a scribe by scribe study and analysis written to introduce the actors who produced the economic texts studied here, as well as the mathematical knowledge each actor exhibits. The discussion in Chap. 3, then, provides a general context for the texts, while Chap. 4 links the texts to one another and to the scribes that produced them.

The main discussion begins with Chap. 5, which examines number use in the economic texts discussed here, and which is supplemented by Appendix 4, an index of prices, values, and wages from the Old Babylonian kingdom of Larsa. Chapter 5 ties the economic texts and administrative traditions introduced in Chaps. 2 and 3 to a mathematical environment which is fostered by the scribal education seen in Chap. 2. Chapter 6 presents the distinction between mistakes and errors while exploring basic addition. Chapter 7 discusses measurement instruments, practices,

and how these instruments and practices relate to the discrepancies discussed in this work. In Chap. 8, estimation in the form of revenue, prices, and labor calculation are all discussed. This brings us to Chap. 9, where rounding in the scribal education and in the economic texts themselves will be described. Here, the reason behind rounding numbers becomes apparent, and how rounding numbers related to the mathematical processes introduced in the prior chapters. Appendix 5 supplements Chap. 9 and presents tables that catalogue errors, mistakes, and examples of rounding in each text. Finally, Chap. 10, the conclusion, discusses rounding numbers, how this was expressed in the various forms of scribal education, and what this tells us of the scribal education. The appendixes are followed by the bibliography, a word index, a name index (personal and geographic), a text index and a general index.

Crossing between the history of mathematics and Assyriology has proved a challenge for this volume, which presents both a mathematical study and a textual study. However, a particularly difficult boundary between the history of mathematics and Assyriology appears with the textual study. In history of mathematics, primary sources are typically referred to by their museum number. In Assyriology, primary sources are often referred to by their primary publication and these are often given in glosses. A decision had to be made as to how to reference each text and these references needed to be followed consistently. Thus, it was decided early on that museum numbers are the most efficient and consistent way to refer to texts. However, not all texts have a museum number! Thus, texts published by Riftin in 1937 are referred to as Riftin 1937, and then the number provided by Riftin, rather than as Erm—. To facilitate consistency, Ur Excavation Texts are referred to as UET because not all texts in this series have full museum numbers, or even excavation numbers. Their primary publication is the best way to reference these texts. To preserve clarity, Assyriological glosses used to refer to primary publications are largely avoided here. However, these glosses are listed just after the list of abbreviations to tell the Assyriologist that, for instance, Riftin 1937 is often referred to as SVD or SVJAD. The goal, whether successful or not, is transparency for both the historian of mathematics and the Assyriologist.

In this way, each text edited here is assigned a museum number, or another number commonly used to designate each text in the collection where it is located, followed by a CDLI number[2] indicating where, when available, an image or copy of the text can be seen and where additional document details can be found. Following this is a list of where the copy of each text and other editions can be found. Because this study focuses on discrepancies, it was deemed vital to view

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[2]CDLI stands for the Cuneiform Digital Library Initiative, a joint project of the University of California, Los Angeles, the University of Oxford and the Max Planck Institute for the History of Science, Berlin. The purpose of CDLI is to catalogue cuneiform texts, including high resolution photographs or copies and transliterations when available, publication information, collection information, and more, as well as multiple search parameters. Each object is catalogued by a CDLI number which serves as one search parameter on this database. See https://cdli.ucla.edu/. Accessed 30 June 2018.

each object if possible, as well as other collations, so that a list of collation dates and publications follows. After this comes the date formula. Additional background information is provided before the texts themselves appear in transliteration and translation, followed by notes regarded as important for the study of the text in general and discrepancies in these texts in particular.

When interpreting a text, tables will attempt to differentiate between values found on the text in question according to the following conventions: if a measurement value or a number is derived directly from a value or number found on the text, such as a transformation from a measurement value to sexagesimal place value notation (henceforth SPVN), italics is used. When presenting a modern, unstated transformation, whether from a measurement value to a SPVN number, or from a SPVN number to a measurement value, an arrow (→) is used, which shows the direction of the transformation. This transformation is then followed by the metrological table from which the transformation is derived. If a number is not found in the text but is a calculated number instead or a value based on information found on a text, it will appear underlined. When an expected measurement value or a number deviates from what is written on the text, then it appears in bold. The word 'transform' is used in this volume, following Christine Proust's advice in private conversation to denote a mathematical process of movement between measurement or numeric values and SPVN numbers, that is, between discrete value and floating or abstract numbers.

This volume attempts to express numerical and measurement values in translation and discussion with the maximum possible transparency. Thus, in translation and interpretation, measurement values are stated as closely as possible to the form in which they are expressed in the texts. For instance, written '1(diš) gin_2' are translated as '1 *gin*' and appear as such in interpretation and discussion, not as '1 shekel'. The written form '2/3 ma-na' will appear as '2/3 *mana*', not '2/3 *mina*'. Numbers, such as '1($geš_2$)' in system S will appear as '1 × 60' in translation and commentary, while '1(geš'u)' is translated as '10 × 60', '1($šar_2$)' is translated as '1 × 60^2' while '1(šar'u)' as '10 × 60^2' and so on.[3] An artificial, modern place value notation, such as that espoused by Sollberger (1966: 7) for capacity measurement values, will not be used in this volume to express value in translation or interpretation.[4] The reasons for this approach are threefold. First, it is intended to make the texts and interpretations more transparent to the non-Assyriologist who may be interested in this study. Second, metrology as it appeared in the texts is

[3]See Chap. 2 for discussion of these metrological and numerical systems.

[4]In Sollberger's 'transliteration' system, quantities for *gur*, *bariga* and *ban* are transliterated as integer numbers or fractions with a defined magnitude and separated by a period (.). Thus, 1 *gur* in the capacity system is transliterated as 1.0.0, 1 *bariga* as 0.1.0, 1 *ban* is 0.0.1. A final measurement value, *sila*, is separated from these values by a space or appears independent of these values. While this system may be convenient to the Assyriologists, as Proust (2009: §6.4) states '"positional" transliteration is a source of confusion because it gives the reader the impression that the ancient system is positional, which is not the case. Moreover, it implies 'an anachronistic use of zeroes'. For a discussion of the capacity system, see Chap. 2 in this volume.

distorted if it is based on modern conventions by which measurement or numerical values are expressed as if they are biblical or modern measures or in a place-value system, as is commonly done in Assyriology today. Indeed, when a modern, artificial place value notation is used to express numbers, it cannot be understood as a translation but instead as an interpretation of numerical or measurement values. Third, and this will become more evident in Chap. 2, transliteration and translation here attempt to mirror how measurement values appeared on the metrological lists and tables as learned in the elementary phase of the scribal curriculum, so that transformation is easier to understand when written in this way. For these reasons, such modern systems of interpretation must be ignored or adapted here because metrological and numerical values are the basis of textual study.

In addition to a note on numbers and measurement values, calculations themselves as found on the texts can be difficult to understand. This is true even for the experienced mathematician. The calculations here were each checked online using a tool, *Mesocalc*,[5] which was developed by Baptiste Mélès with the guidance and advice of Christine Proust. This tool can be used by anyone unfamiliar with mathematics in the Old Babylonian period to perform a calculation, as well as by experienced historians of Old Babylonian mathematics to double-check work.

Some basic, and in some cases tentative definitions should also be laid out concerning errors and mistakes. First, as stated above, an error, as tentatively understood here, is intentional, or the scribe is aware it could exist. Errors result from the scribe's own computational culture acting on the scribe to produce an acceptable discrepancy. A mistake is understood here as an unintentional discrepancy, the result of the scribe's own inattentiveness. Discrepancy is used here as a neutral term to describe the difference between what is expected by the modern observer and what is stated in a text. This discrepancy could be the result of anything, from the modern reader's misunderstanding of an ancient practice to a scribal mistake. An approximation is understood as a stated value or number that is close in value to, though not the same value as the true or expected value or number. The actor who stated the approximate value or number is aware it is probably not the same as the true or expected value or number. A rounded value or number is understood as an intentional discrepancy that occurs when the expected value or number is replaced by another value or number that is near to this expected value or number but shorter, simpler, or presents a more concise statement than the expected value or number. Truncation is also an intentional discrepancy that occurs when part of a value or number is either rounded off or simply removed. It is then considered as a kind of rounding. Estimation is used to describe a calculated approximate value or number. An estimation does not state reality, only an expected or projected reality.

Finally, this work centers around the kingdom of Larsa, the capital of which was the city of Larsa. In this work, the city Larsa is referred to either as 'the city of Larsa' or simply as 'Larsa', while the kingdom itself is referred to as 'the kingdom

[5]Mélès et al. (2013–2018): Mesocalc: A Mesopotamian Calculator, http://baptiste.meles.free.fr/site/mesocalc.html, accessed 30 June 2018.

of Larsa.' This can be hard to distinguish at times. However, we are ultimately referring to the crown which is based in and derives its power from the city of Larsa, so that reference to political power must be to the city itself or the king, and not the kingdom which expanded and contracted with the city's fortunes.

1.2 An Overview of the Kingdom of Larsa, Past and Present

The scope of research here is limited to the Old Babylonian period in southern Mesopotamia, specifically the kingdom of Larsa, so that it is important to briefly present this kingdom, its rulers, chronological issues of the Old Babylonian period and the modern archaeology of the ancient city of Larsa. The Old Babylonian period begins with the collapse of the third dynasty of Ur and the rise of the kingdom of Isin around the end of the twenty-first century BCE. While the prior two kings were subordinate to the kings of Isin, the kingdom of Larsa was firmly independent from the kingdom of Isin with the reign of *Sāmium* (1976–1942 BCE). At its height under the reign of *Rīm-Sîn* the kingdom of Larsa controlled the entirety of what would become southern Babylonia, including the cities of Ur, Uruk, Nippur, and finally Isin, from *Rīm-Sîn*'s thirtieth year in power. The kingdom retained independence until *Hammu-rābi* of Babylon conquered it in *Rīm-Sîn*'s sixtieth regnal year, 1763 BCE. Larsa and all of southern Mesopotamia remained under Babylonian supremacy through the rest of *Hammu-rābi*'s reign and for the first dozen years of the reign of *Hammu-rābi*'s son, *Samsu-iluna*. Around *Samsu-iluna*'s tenth year in power, the city of Larsa revolted, along with the rest of southern Babylonia. The violent suppression of this revolt would leave southern Babylonia in ruins for the remainder of the old Babylonian period.[6]

Eight kings of Larsa are represented in the texts here, *Gungunum*, *Sūmû-el*, *Nūr-Adad*, *Sîn-iddinam*, *Warad-Sîn*, *Rīm-Sîn*, *Hammu-rābi* and *Samsu-iluna*. The latter two, *Hammu-rābi* and *Samsu-iluna*, were kings of Babylon who ruled the kingdom after Larsa's conquest by *Hammu-rābi*. Table 1.1 lists all the kings of Larsa from the collapse of the Ur III state to *Samsu-iluna*, including the rebellious *Rīm-Sîn* II.[7]

Fitzgerald (2002: 35) notes that while the Larsa king list starts with *Naplanum*, the first king who certainly ruled this city was *Zabāia*. In addition, *Hammu-rābi* only reigned at Larsa for the last nine years of his reign. His rule in Babylon started in 1792.

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[6]This is not the place for a discussion of the political vicissitudes of the Old Babylonian period. For an in-depth discussion of the political history for this time period, see Charpin (2004b). For the independent kingdom of Larsa in particular, see pages 68–74 and 76–127. For *Hammu-rābi*'s conquest of Larsa, see pages 317–324, while the revolt of the kingdom of Larsa under the reign of *Samsu-iluna* and its aftermath are discussed on pages 337–346.

[7]For a survey of the kings mentioned here, see Fitzgerald (2002). See Van de Mieroop (1993) for a more in-depth discussion of the reign of *Rīm-Sîn*, and Charpin (2003a) followed by Van de Mieroop (2005) for more in-depth discussions of the reign of *Hammu-rābi*.

Table 1.1 Rulers of Larsa

Royal name	Start	End
Naplanum	2025	2005
Iemṣium	2004	1977
Sāmium	1976	1942
Zabāia	1941	1933
Gungunum	1932	1906
Abī-sarē	1905	1895
Sūmû-el	1894	1866
Nūr-Adad	1865	1850
Sîn-iddinam	1849	1843
Sîn-irībam	1842	1841
Sîn-iqīšam	1840	1836
Ṣillī-Adad	1835	1835
Warad-Sîn	1834	1823
Rīm-Sîn	1822	1763
Hammu-rābi	1762	1750
Samsu-iluna	1749	1712
Rīm-Sîn II	1740	1736

After Fitzgerald (2002: 156–164) and Roaf (1990: 110–11)

1.2.1 The Trouble with Chronology

However, a serious caveat must be mentioned concerning the dates just listed. While the number of years the Old Babylonian kings reigned is reasonably certain, the dates of each king's reign are uncertain because chronology is still a debated topic in Old Babylonian history. There are three main hypotheses: the high chronology espoused by Huber (1999–2000), the low chronology argued by Reade (2001) and the middle chronology which is the most widely used today (Mcintosh 2005: 46–47). The earliest relatively certain date of Mesopotamian history is about 910 BCE, when the preserved examples of the Assyrian eponym list break off and scholars have to guess between different regnal dates. See Hunger (2009: 146) for this. On Babylonian chronology, Hunger (*ibid.*: 149) states:

> Applying the three chronologies to the well-known king Hammu-rapi of Babylon, his reign is dated as follows:
>
> "High chronology": 1848-1806 BC
>
> "Middle chronology": 1792-1750
>
> "Low chronology": 1728-1686
>
> The end of Hammu-rapi's dynasty, which occurred 155 years after his death, is therefore placed in 1651, 1595, or 1531 BC respectively.

An even lower chronology places *Hammu-rābi*'s reign between 1696 and 1654 and the end of the dynasty at 1499 BC (*ibid.*: 149). See Hunger's (2009) article for a

concise description of this debate. The middle chronology is followed here out of convenience, because it is the most widely used today.

1.2.2 The City of Larsa, Its Environs and Modern Archaeology

While chronology is problematic, the archaeology of the city of Larsa has its own problems. This city's modern history begins in 1853, when Loftus and Rawlinson identified the modern site Tell Senkereh as the ancient city of Larsa (Edzard and Farber 1974: 111). Loftus (1857: 244) described it in his report as a low, circular platform rising to about 70 feet (21 m) above the plain, with a circumference of about 4.5 miles (7.25 km). The ruins were visible from the ancient city of Uruk, modern-day Warka. The city itself lies about twenty kilometers east of the Euphrates and west of the Tigris. A canal running from Bad-tibira to the east of Larsa and through the city supplied it with water and connected it to the rest of the kingdom (Adams and Nissen 1972: 39 and map p. 36). Loftus (1857: 244) described this site as rich in tablets: 'So numerous were the clay tablets, I almost arrived at the conclusion that the fine brown dust of the mounds resulted from their decomposition'!

Loftus' expedition occurred in the mid-nineteenth century. The main aim of this expedition was to outline buildings, ascertain the importance of the site and then to recover valuable antiquities.[8] He was scarcely interested in the myriad texts that he reports as covering the mound, which meant that scientific excavations would wait until Parrot's excavation in 1933 (Parrot 1933, 1934). In the meantime, Tell Senkereh was plundered extensively for texts and artifacts, flooding the antiquities market with tablets that eventually filled the collections at Yale, the Louvre and elsewhere. Parrot (1933: 175) writes as follows of that first campaign in the city:

> A quelque 20 kilomètres à l'orient de l'Euphrate (croquis, p. 172), au milieu d'un désert de sable, les monticules désolés, qui recouvrent les ruines de Larsa (aujourd'hui Senkereh), furent dans le courant de l'année 1931, soumis à un pillage sévère. Ils n'étaient d'ailleurs pas inconnus des fouilleurs clandestins, qui, depuis longtemps, y faisaient des prélèvements destinés à alimenter le commerce des antiquaires de Bagdad. Ainsi arrivèrent sur le marché les innombrables tablettes, lettres ou contrats. Au printemps 1931, le pillage recommença, mais cette fois à grande échelle et systématique, et il y fallut l'intervention de plusieurs avions pour arrêter des travaux qui avaient déjà commis de graves ravages, tant parla transformation du site bouleversé de milliers de trous que par les découvertes précieuses réalisées en peu de temps et dont il a déjà été possible de se rendre compte, d'après les objets arrivés sur le marché.

[8]See Loftus (1857: Chap. 20, 240–62) for his work there.

Thus, the vast majority of texts from this city, the capital of the kingdom of Larsa which at its height ruled much of Southern Babylonia,[9] are unprovenanced. Their origin is suggested by modern scholars, sometimes based on the few texts resulting from scientific excavation.[10] Indeed, the majority of texts studied here are derived from these unscientific digs that populated the early collections.

Excavations continued at Senkereh in 1967 again by Parrot (1968), with additional campaigns directed by Margueron in 1969 and 1970 (Margueron 1970, 1971). Further excavations were led by Huot between 1976 and 1991,[11] with all excavations primarily focusing on occupations of the Old Babylonian period and later. However, texts have been recovered from these excavations, such as those discovered in the sixth season of excavation (cf. Calvert et al. 1976) in the Ebabbar temple and described by Arnaud (1978), or those found in merchant households and discussed by Charpin (2003b). As Arnaud (1978: 165) explains, texts were picked up on the surface or found in fill, and some in situ, that is, in their proper context.

1.3 Current Trends in Assyriology

In the case of many texts from the city and kingdom of Larsa, much information about provenance is lost, whether because the texts were discarded in antiquity or pillaged by modern looters. Thus, textual analysis plays a vital role in reconstructing the original provenance of these texts, as well as the history and fortunes of the kingdom of Larsa itself. Throughout the existence of Assyriology, textual analysis has been adapted to follow the needs of this discipline in exploring the history and society of Mesopotamia. Indeed, it is essential to understand the approaches to textual use and identification in Assyriological studies in order to understand problems associated with these approaches as well as useful models in collecting and interpreting numeric data. Current perspectives in Assyriological studies and textual analysis can offer useful tools for textual interpretation.

1.3.1 Archival Studies

The latter half of the twentieth century until the present day is a period of research characterized by examining texts as parts of archives. This is quite apparent in both

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[9]For a historic map of the kingdom of Larsa, see Roaf 1 (990: 109). Note, the kingdom of Isin would be incorporated into the kingdom of Larsa in *Rīm-Sîn*'s thirtieth year, around 1793 BCE.

[10]See, for instance, Arnaud's catalog of 183 inscribed tablets and objects derived from the sixth season of excavation at Larsa (Arnaud 1978) or those texts discussed by Charpin (2003b) found in merchant households of Larsa.

[11]See Calvert et al. (1976), Huot et al. (1978), Huot (1983, 1985, 1987a, b, 1989). Excavation reports extend through the 1985 season.

the scholarly and the administrative/economic traditions. With administrative texts there has been a shift over the years toward creating archives. Foster (1982a) notes a distinction between three archive types based on location and household size. According to Foster (1982a: 7), there are family or private archives, household archives and great household archives.

While this distinction is valid, a slightly different distinction is preferred in the present work: there are personal household archives, often indicated here by the shorthand 'personal' or 'household,' such as that extensively studied on *Šēp-Sîn* of Larsa, first published by Anbar in 1975 and 1978, and which has attracted much attention since. There are also what may be called merchant archives, that is, texts representative of an administrative system such as the *sūtu* texts first studied by Koschaker (1942) and taken up again in this period by Charpin in 1980 and Stol in 1982. Finally, there are craft or bureau archives, both labeled bureau archives here, such as the Isin archives studied by Van de Mieroop (1987), the Larsa oil bureau archives reconstructed by Charpin (1979) or the Mari oil bureau archive published by Soubeyran in 1984. The 1970s and 1980s saw a flowering of textual analysis within corpuses. This period would see the development of methodologies to examine these collections and would result in several interesting studies.

For instance, an archival approach helped to elucidate the administrative environments of ancient Mesopotamia. Through this approach, Foster (1982b), writing in 1982, was able to illuminate educational practices in the Sargonic period. To Foster, some of the texts researchers previously believed to be administrative texts are in fact educational texts used to educate a young scribe in a specific bureaucratic setting. This is a significant difference from the Old Babylonian period when there was a clearly defined scribal curriculum [see, for instance, Veldhuis (1997), Tinney (1999), Robson (2001b), Proust (2007) and Delnero (2010)]. It also raises the question of how to define texts that on outward appearances claim to be something they are not. Foster's construction blurs the boundaries between mathematical texts and administrative texts.

More recently, Hallo's 2004 study succeeded in reconstructing a particularly advanced accounting system in the Ur III period. Hallo's study presents multiple tablet types that were used in a record-keeping procedure somewhat resembling modern double entry bookkeeping. Double entry bookkeeping is here understood as a system of record keeping in which each transaction entered into an account, a debit, has a corresponding and opposite entry in an additional account, a credit.[12] In both Foster's and Hallo's discussions, tablet features such as typology (whether a tablet is multi-columned, single columned, bullae, etc.) or whether an image is present on a tablet, as well as text types such as receipts and deliveries, occupy a prominent place in reconstructing and examining the corpuses.

In reconstructing archives such as those mentioned above, scholars have begun to piece together regional variations and patterns in economic and social systems.

[12]This system probably continued into the Old Babylonian period, as suggested in Chap. 3 and explains several different archives and bureaus presented here in Chap. 4 and Appendix 2.

Thus, for instance, the formation of a distinct social, economic or political system in Old Babylonian Ur is presented in the above-mentioned reconstruction of the city by both Charpin (1986, 2000) and Van de Mieroop (1992). An earlier study on similar lines was conducted by Rivkah Harris on Old Babylonian Sippar (1975). This archival method is also used by Yoffee (1977) to reconstruct the late Old Babylonian economy in the north while a similar, although more extensive archival approach is taken up again in Goddeeris' work (2002) on the early northern Old Babylonian economy. Here, whenever possible, the location of a scribe is suggested to help elucidate regional variations in mathematical processes.

Both Charpin (2003a) and Van de Mieroop (2005) exploit these methods of integrating texts around an individual to create biographies of King *Hammu-rābi* of Babylon. The work of Van de Mieroop, which is the more recent of the two, will be examined here. In his book Van de Mieroop uses three main source groups that can be divided into two text types: The first type of text is letters, either letters from the north of Mesopotamia, in particular from the city of Mari, or a second group of letters from the south of Mesopotamia, most notably from *Hammu-rābi* to his administrators in Larsa. The second source type is royal imagery such as names of the years found on the economic, administrative and legal texts as well as royal inscriptions such as the law stele of *Hammu-rābi*. Van de Mieroop used these groups to create a more intimate image of the famous king and his personality than was previously available.

Van de Mieroop's treatment of *Hammu-rābi*'s law stele is interestingly similar to a literary critical model. The law code itself is only part of the text. And the text is only part of the stele. Thus, the stele is divided into four parts, not three: a relief at the top, a prologue, the code itself and an epilogue. Van de Mieroop (2005: 122) states at the very beginning of his interpretation of the stele:

> The code of Hammurabi remains an eloquent and powerful statement: the king was a man of justice, the shining example of a just ruler to be remembered for eternity. This peaceful image dominates the text, but it was not the only one that Hammurabi's court wanted to convey in this and other official statements. The code makes clear that he could dispense justice only because he had conquered – or in his words pacified – the world. It portrays thus an age-old belligerent ideology that military action is a justified means to bring peace and justice to the conquered lands.

1.3.2 Unity Out of Variety

The awareness of regional and temporal variation has been accompanied by attempts to isolate particular points in time and place and reconstruct an aspect of society surrounding these points. This seems to be evolving into an attempt to construct the essentially Mesopotamian out of this regional and temporal variety. One need only look at Leick's book (2002), *Mesopotamia: The Invention of the City*. In this book Leick reconstructs Mesopotamian history by examining ten prominent Mesopotamian cities in depth, particularly emphasizing their high points

in history. This creates the impression of a unified history and culture but with strong regional variants. No city is typically Mesopotamian because they are all representative of the region, although each city retains its own identity throughout its existence.

Van de Mieroop's 1999 work, *Cuneiform Texts and the Writing of History,* would seem to espouse this viewpoint. The purpose of this book is to examine new approaches to the writing of history that had appeared or were appearing at the time of its writing: What Van de Mieroop calls 'history from above' which emphasizes royal inscriptions, 'history from below' in which prosopographic studies and personal narratives are present, economic histories and finally gender issues. Van de Mieroop's above-mentioned biography of *Hammu-rābi*, especially his points on history from above and personal narratives, as well as his work on Old Babylonian Ur discussed above, where his use of history from below and his economic history approach are evident, all reveal the methodology espoused in his 1999 work on textual analysis.

History from below can be seen in Yoram Cohen's discussion of scribes from the City of Emar in Syria (Cohen 2009). While this book's purview is outside of Mesopotamia, it deserves mention here due to its use of sources. Cohen's book aims to produce an image of the scribes and scholars who worked in the city of Emar in the late Bronze Age (the latter half of the second millennium BCE). An intimate portrayal of individual scribes is produced by examining texts divided first by archive, and then looking at the scribes active in these archives in order to reconstruct two scholarly traditions, a Mesopotamian and a Hittite tradition. Thus, archives are subdivided to delimit individuals active in the city and through this a picture of scribal activity and education is produced.

Veldhuis's 2011 article on literacy types can probably also be called a history from below. Veldhuis distinguishes three types of literacy: functional, technical, and scholarly. In his work, Veldhuis points out that much of education aimed at a kind of scholarly literacy and the construction of an elite identity, even if this education certainly contained aspects necessary for a functional literacy. Veldhuis, citing both Wilcke (2000) and Charpin (2004a), argues that there was probably a more universal functional and even technical literacy: 'In the Old Babylonian period (for which the best evidence is available) the majority of houses in Nippur and Isin yielded texts, including school texts. Several other sites seem to confirm that picture' (Veldhuis 2011: 71, citing Wilcke 2000). A functional and technical literacy probably occurred outside of the classroom and in a professional setting, such as an apprenticeship. (*ibid.*: 82–86). Unfortunately, Veldhuis (*ibid.*: 85) states, the evidence for this apprenticeship is difficult to find, if it exists at all:

> First, they use the same formulary, the same conventions, and the same format as real documents because that is exactly their point: to train the student how to do it properly. Our chances of distinguishing between real documents and the products of a trainee are therefore relatively low. Second, whereas real letters and documents may have been filed and kept safely for at least some period of time, there was no reason to do that for exercise

> documents. Finally, apprentices may have started relatively early in drawing up real documents under the supervision of their master, so that the whole distinction between school texts and archival texts collapses.

Veldhuis, however, speaks primarily of a lexical education, so that it is difficult to ascertain the utility and universality of the elementary mathematical education from his work. While he finds that lexical lists were aimed at preserving a glorious Sumerian past (*ibid.*: 85), Veldhuis (*ibid.*: 84) admits to the general utility of the metrological and numerical exercises for administrative purposes, leaving the reader wondering if these were learned more universally, outside of the classrooms and in professional settings, or even whether there was a more universal elementary education (see Chap. 2 in this volume for this).

Finally, Michalowski's (2012) work on Old Babylonian scribal education can also be described as history from below. Like Veldhuis, Michalowski sees an unseen professional education at play with most scribes. However, Michalowski's work is less pessimistic with regard to the visibility of this professional scribal curriculum. To Michalowski (*ibid.*: 43), the literary works which attest to the advanced education in the scribal curriculum are not necessarily the only scribal curriculum but are, instead, part of a distinct educational process. Instead of this education, most scribes probably participated in a more utilitarian secondary education, a 'limited practical Old Babylonian scribal training'. Michalowski (*ibid.*: 47) regards utility as an important distinction. Speaking of mathematics in particular, he states:

> Mathematical knowledge that was taught in Old Babylonian schooling establishments was not only theoretical, but practical as well, and presumably could be of some use later in life for those who needed it. As Friberg has recently demonstrated, there is evidence of real-life application of such learning already in Ur III times. On the other hand, there are limitations to the scope and intensity of the application of theoretical knowledge in real-life situations and obvious imbalances between practical interest and knowledge outside schooling environments.

Michalowski is citing Friberg (2009) here. The utility of an education presents an important distinction which allows for the possibility of multiple, professional educations of limited oversight and degree. For instance, one may ask, was there an economic model at play when it comes to irrigation and excavation? See Sect. 8.3 for this. Michalowski's hypothesis evokes the possibility not only of regional variety in education but of variety based on profession and social status.

In mathematics there are several potential routes for current researchers to take. In the early twentieth century, Assyriology saw brilliant works in mathematics with the study by Otto Neugebauer in his *Mathematische Keilschrifttexte* published 1935 and 1937, and his work with Abraham Sachs in the famous 1945 publication of *Mathematical Cuneiform Texts*, as well as the work of François Thureau-Dangin and his *Textes mathématiques babyloniens* published in 1938. These works had a significant impact on Assyriology as they inspired awareness of a pre-Greek mathematical culture in ancient Mesopotamia. However, to aid in understanding these mathematical texts, modern algebraic notations were used to describe Mesopotamian problem-solving methods. Differences in word use were obscured

by modern notation, which caused both Neugebauer and Thureau-Dangin to ignore differences in word choice, even when they seemingly expressed the same operation in a single text. It must be stated that the challenge these authors overcame in their studies was simply to interpret the texts correctly, not to examine the regional and cultural relevance of these texts. Moreover, a chapter of *Mathematical Cuneiform Texts* written by Goetze (1945) did show distinctions within the mathematical corpus. Goetze did this by employing techniques typical for his time: he divided the tablets up into five groups based primarily on language, sign choice and sound differences.

However, Høyrup's (2002) publication *Lengths, Widths, Surfaces: A Portrait of Old Babylonian Algebra and its Kin* re-examines the technical processes visible within many of the mathematical texts studied by Neugebauer, Sachs and Thureau-Dangin. Høyrup exploits differences in word choice to create a new image of Mesopotamian mathematics, an approach which Høyrup terms 'a conformed translation'. This allows him to better elucidate procedures presented in the texts as they were understood by the Old Babylonians, what Høyrup calls 'cut and paste geometry'. This examination also allows Høyrup to improve on Goetze's group divisions in *Mathematical Cuneiform Texts*.

Another method for studying mathematical texts is to critically examine the use of numbers in the texts. This was done by Proust (2000) to show the existence of an abacus in achieving mathematical results by use of systematic mistakes in computational results. Proust's examination shows that the same kinds of mistakes occur in the Old Babylonian period and in the Seleucid period, a time difference of over a millennium.

A third route, taken by Nemet-Nejat (1993), Robson (1999) and Friberg (2001) is to examine the implications mathematics could have on economic texts. Nemet-Nejat's work (1993), *Cuneiform Mathematical Texts as a Reflection of Everyday Life in Mesopotamia*, is an encyclopedic discussion of mathematical processes in the cuneiform data that must have had a bearing on everyday life, from construction works (*ibid.*: 27–54) to agricultural activities such as field planning (*ibid.*: 72–77). Robson's work (1999), *Mesopotamian Mathematics* 2100–1600 BC*: Technical Constants in Bureaucracy and Education*, is especially important in reconstructing mathematical constants and coefficients that were part of many bureaucratic procedures, from brick constructions (*ibid.*: 57–73) to storage systems (*ibid.*: 111–124). In turn, Friberg's work (2001), 'Bricks and mud in metro-mathematical cuneiform texts,' does much to elucidate construction activities specifically, whether these activities are brickworks or excavations, etc. All this helped to develop a firm foundation in technical studies concentrating on administrative functions, especially in the 1990s and early 2000s.

These critical readings of texts have shown multiple microcultures in mathematical practices in one single period while also pointing to a continuity of practices throughout Mesopotamian history. In this volume, a microculture is a culture that exhibits and relies on a larger culture but that shows slightly different nuances in expressing this culture. It adds to this culture by expounding on aspects unknown to the culture, or it engages in a current dialogue within the culture in order to define

this culture in the future. Thus, a microculture is not a subculture because it is not at odds with the greater culture in order to create change but is actually a vital part of cultural growth.

These critical readings reflect a general trend in Assyriology at work today. Bureaucratic procedures found both in economic and in mathematical texts are being explored. Assyriology today is creating a variegated regional tapestry in order to produce a distinctly Mesopotamian history which incorporates understandings of both economic data and mathematical processes. The use and distinctions made between texts reflects this.

1.3.3 Archives and the Parameters of Study

It is proposed here that by examining error and mistake in economic texts, an image of mathematics as learned in the elementary and advanced education of each scribe will emerge. Whenever possible, provenance for each text is suggested and, more importantly for the investigation of educational practices and numeracy, the origin of the scribe or official who carried out a mathematical operation is hypothesized. This could help to understand the various microcultures of mathematical practices, which may lead to a more general understanding of how rounding numbers was conceived and used.

Here, history is approached from below, a method espoused by Van de Mieroop and similar to Cohen's approach at Emar as well as Veldhuis' and Michalowski's discussions of scribal training. Focus is on discrepancies in measurement values and numbers, similarly to Proust's approach mentioned above, and then terminological choices within texts, analogously to Høyrup's approach in his 2002 work. This study incorporates aspects of the archival studies used by Anbar, Van de Mieroop, Charpin and Stol. Texts are divided first by archive when possible, then by scribe, to produce an image of mathematical practices as they are applied to the various administrative environments. This practice is described in the elementary phase in Chap. 2, number use in Chaps. 5 and 6, a discussion of error and uncertainty in estimation in Chap. 8 and then through rounding itself in Chap. 9. In the case of Chaps. 3 and 4, however, supplemented by Appendix 2, the basis for a discussion of these archives and the scribes who wrote them is laid by a description of the texts and tablets they are written on as well as the bureaus and scribes that produced these texts.

1.4 Mistakes and Errors—Preliminary Remarks

This study uses mistake, error and rounding numbers as a method to examine mathematics learned and used by each scribe. The hypothesis is that rounding numbers and other discrepancies offer a tool that can be used to detect how the

systems of quantification were understood and manipulated by the scribes themselves. Before this study can begin, however, it may be helpful to mention a few aspects of each. First, I am aware of very few studies devoted to mistakes or errors concerning Mesopotamian mathematics, let alone for the Old Babylonian kingdom of Larsa, of which Brunke's 2012 work on geometric approximations is an example. One such discussion is Proust's above-mentioned article from 2000, which uses mistakes in the results of calculations to show that an abacus was used to carry out multiplications. Proust distinguishes between two varieties of discrepancies in the texts: mistakes in writing, such as epigraphic mistakes where the scribe forgets an intended wedge signifying ones or tens, and then mistakes specific to the use of SPVN (see Chap. 6 for further details).

Geller and Geus (2012: 3) address a general lack of mathematical information on discrepancies in pre-Classical Greek mathematical thought:

> Nevertheless, at a more theoretical or advanced level, mathematics requires more than training but a special aptitude to numeracy in order to grasp more abstract mathematical concepts, and not every pupil (or even teacher) will possess this innate ability. Moreover, since we have little in the way of mathematical textbooks from pre-Classical antiquity, we often depend upon school exercises and mathematical riddles for knowledge of mathematical theory and how these theories may be applied to everyday situations. What we do not know, therefore, is who was actually responsible for mathematical theory and applications before we encounter Euclid's Elements and Archimedes' work, as well as first (sic) actual mathematical textbook, probably the Elements of Hippocrates of Chius, c. 400 BCE. Yet there is no specific profession associated with mathematics, as there is for medicine, magic, divination, liturgy or music. Who defined the weights and measures, designed the bookkeeping, and thought up the riddles? All this data from early antiquity is intriguingly anonymous and clouded in mystery.

The theory surrounding professional and academic practice is never explained and so it is up to the historian of mathematics to explore, if at all possible, what this theory was.

Outside of mathematics, there are numerous discussions of mistakes in Mesopotamia, especially concerning the scribal curriculum. For example, Delnero (2012) compiled a study of mistakes in transmitting literary texts. Mistakes in these literary texts, produced in a scribal setting, were used to suggest they were copied from memory by student scribes, and not from dictation directly from other exemplars. To Delnero, several varieties of mistakes betrayed this: conscious memory errors, unconscious memory errors, visualizing errors, phonetic errors and mechanical errors (*ibid.*: 200–203, 207). The word error is synonymous with mistake in this understanding. Sasson (2002), on the other hand, does discuss the production of mistakes in a professional setting in his presentation of a royal letter from the city of Mari. By exploring discrepancies between texts, Sasson is able to show that administrative scribes probably copied from dictation when compiling letters to multiple persons. In particular, seemingly orthographic mistakes, that is, when one sign is chosen over another expected sign, help to show that a certain mistake was one of oral transmission (*ibid.*: 220–224).

Outside of the Assyriological world, there are also studies on error, especially experimental error in the classical Greek world, such as Hon (1989). Hon's work (1989: 129) suggests two methods which can be used to approach the study of experimental error. One is to focus on the process from the standpoint of history in order to concentrate on the juncture when experimental error was understood, while the other is to contrast different attitudes to it. In his work, Hon uses the latter, comparing Kepler's perception of astronomy with Greek perceptions of astronomy, to remarkable effect. While experimental error is not the focus in this current work, this distinction can be applied to the study of errors in economic documents and educational materials as well. The present study, in contrast to Hon's work, focuses on history in order to perceive how error and, in particular rounding numbers in the economic texts, was affected by the scribal curriculum, and what can be gleaned of the curriculum and education from this. Can the ancient scribes' own understanding of error be elucidated? The present study also offers a comparison of individual scribes. Thus, while it takes a historical approach, it allows for future study based on comparison.

Different types of mistake and error are a subject of discussion in the history of science, including typologies of experimental mistakes and errors. Thus, Mayo (1996) distinguishes between four canonical types of mistake in research, adding a fifth mistake in her revised summary of (2010: 04):

- mistaking chance effects or spurious correlations for genuine correlations or regularities
- mistakes about a quantity or value of a parameter
- mistakes about a causal factor
- mistakes about the assumptions of the data (for the experimental inference)
- mistakes in linking experimental inferences and subsequent claims or theories.

Allchin (2001: 4), in turn, points to four main types of discrepancy in science as well: what he terms material errors, observational errors, conceptual errors, and discursive errors. Material errors, to Allchin, 'involve generating a particular phenomenon that a researcher has decided warrants observing' (*ibid.*: 6). Observational errors can be due to the actual observation itself (*ibid.*: 7). Conceptual errors occur after observation and include 'inappropriate statistical models, unwarranted experimental assumptions, misspecified boundary conditions, cognitive bias due to theoretical entrenchment, cryptic theoretical alternatives, and flaws in reasoning, such as computational error and the classic failure of induction' (*ibid.*: 8). The last type of errors, discursive errors, are derived from the discourse of modern scientists themselves and typically involve sociological factors such as prejudices against gender, ethnicity, class, religion, etc. as well as fraud (*ibid.*: 8–9). Both Mayo's and Allchin's distinctions are produced so that modern scientists can learn from past mistakes to improve their own practices. As Asper (2012: 48) points out, however, 'it is evident that such an essentially practical perspective cannot be interested in thinking about the status of error itself'. Thus, neither Allchin nor Mayo make distinctions between mistakes and errors, which inevitably raises the question: What is the distinction between the two?

Hon (1995: 6), perhaps, has an answer to this:

> I seek to sustain here a distinction between two ways of going wrong which I call respectively the way of mistake and the way of error. I associate mistake with avoidable ignorance. A mistake can be avoided since checking procedures are known and available. By contrast, error is associated with unavoidable ignorance, when one applies techniques to novel phenomena, when one does not have the security of a well studied, agreed standard procedure—When one gropes, so to speak, in the dark. Metaphorically, a mistake occurs when one goes wrong on *terra firma*, but going astray in one's exploration of *terra incognita* amounts to an error.

For now, the typologies of discrepancies made by Mayo and then Allchin, both focus on mistakes, while Hon's typology is more nuanced, making a distinction between mistakes and errors. To Hon, mistakes presuppose a true value, a value from which one may deviate through avoidable ignorance. Mistakes are also deviations from a rule, an agreed-upon practice (*ibid.*: 9). Error, in Hon's understanding, can be a proposition that is assigned a true value and that is ultimately proven wrong. There is no agreed-upon practice to detect whether a flawed assertion of true value exists (*ibid.*: 9).

Asper adds a further nuance to the concept of error itself, proposing a distinction between 'true' and 'false' errors. Asper (2012, 54) argues that error must be examined and described from a social rather than an epistemological setting. A procedure that would, from a modern perspective, produce an unacceptable or unnecessary discrepancy is 'false' when it is socially established as acceptable, that is, when the author intentionally made an error or had no alternative in doing so. Practitioners' knowledge or expert knowledge could both lead to 'false' errors 'because the solution fulfills the criteria of competence and traditionally accepted appropriateness' (*ibid.*: 58). When speaking of practitioners' knowledge, Aspers (*ibid.*: 54) points to canonical approximations of a solution that were traditionally accepted as correct solutions.[13] Knowledge and error are potentially community based, which raises the question of what defined such communities. Asper (*ibid.*: 63) concludes that,

> In the end, one can doubt whether 'error' is a useful category at all for historians of science (some have denied that). Perhaps one should refrain from adopting an absolute perspective, and rather experiment with more contextually-focused notions such as synchronistic 'success' or 'failure', which would be closer to the notion of 'work flow'.

The present work follows Hon's distinction between mistake and error, while Asper's distinction between 'true' and 'false' error is also observed. Our realm of

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[13]Some of these traditions, and the errors they produced, could span a considerable length of time. For instance, Asper points to a problem existing over a 3000-year period, starting with an Old Babylonian approximation of *pi* as 22/7 or 3 1/7 used in a parallel equation to a Greek text and then a twelfth century Arabic text: 'The problem type $A + d + p = \alpha$, that gives the sum of surface, perimeter and diameter, provides an exact parallel to Hero. This text, however, precedes Hero by about 2000 years. One can find exactly the same problem with the same solution even much later than Hero, e.g., in Ibn Thabats so-called *Reckoner's Wealth*, a collection of conventional computations just like Ps.-Hero, which was written in the 12th cent. AD' (Asper 2012: 52).

activity is mistakes and the pursuit of those ‘false’ errors. Thus, Chap. 6 commences a study of mistakes found in the texts, while Chap. 7 commences a study of error. A mistake is understood as an unintended deviation from an expected or true value, the result of an actor’s inattentiveness to societal rules of calculation. With error, however, a distinction is examined here following Allchin’s distinction between observational errors, that is, errors based on observations such as measurements, and conceptual errors, that is, errors based on calculation or modelling such as an estimation of value based on observed measurements. This is suggested by Brunke’s discussion on geometric approximations. To Brunke (2012), the assignment of measurement values, even though they are approximations, is based on a valid mathematical practice.

The corpus examined here is by and large economic, although it must build on mathematical texts, and especially those produced within or for an educational environment. Thus, discrepancy and its potential creation are isolated in education and practice with the goal of tracing mistake and error, focusing on Asper’s ‘false’ errors. It is hypothesized here, following Asper’s discussion, that some errors, that is, errors produced in an administrative rather than a scientific environment, can be based on customs and practices in order to maintain acceptable deviations from truth. When dealing with the realm of *terra incognita*, as Hon put it, is the author of an economic text aware that there is, or could be, a discrepancy between his assertion and truth? Is the distinction between mistake and error one of awareness? Finally, how does rounding fit into this? These underlying questions of error and mistake will be pursued throughout this study.

Chapter 2
The Early Scribal Education

Abstract This chapter focuses on the metrological and numeric systems that are present in the texts and then forms a hypothesis concerning the elementary scribal education within the kingdom of Larsa that formed each scribe. The first section presents the five metrological systems and four number systems used by the scribes, and describes how they fit together to form a coherent metrological and numerical systems. Following this is a presentation of the scribal education as well as the tablet types and makeup of this education. It will be shown that metrological lists and tables as well as numerical tables formed the backbone of education and calculation. While there was a single, coherent metrological and numerical systems at work in the kingdom of Larsa, this system is expressed by characteristic microcultural variations which may have influenced calculation and the conception of value seen in the economic texts. This chapter is supplemented by Appendix 3, which catalogues metrological lists and tables as well as numerical tables from Nippur, Ur and Larsa.

Before moving to a discussion of error and mistake, two essential questions must be asked, 'what did a scribe's education consist of' and 'how prevalent was this education'? The economic texts that are studied in this work make use of metrological and numerical data. Calculation can only be witnessed in the economic texts when values are present, whether measurement or numeric values. Thus, the basis of these metrological and numerical systems must be investigated and then it must be explained whether and to what extent this basis was present in the elementary phase of scribal education. To answer this, three main questions are pursued here: what systems are used for quantification? how did the elementary scribal education present these systems? was this education uniform throughout the kingdom of Larsa or did it vary?

These questions are difficult but not impossible to answer. First, as seen in Chap. 1, Foster (1982a) succeeded in producing an image of education in an administrative environment for the Sargonic bureaucrat by examining administrative archives. Several features helped to distinguish a scribal exercise text from a regular economic text: lines written in the wrong direction, overly large script,

R. Middeke-Conlin, *The Making of a Scribe*, Why the Sciences of the Ancient World Matter 4, https://doi.org/10.1007/978-3-030-35951-5_2

overly elegant tablets and doodles or drawings on the texts themselves. These texts were also more informal than official records and lacked date formulas. Indeed, at Girsu, Foster (*ibid.*: 238) reviews a large corpus of exercise materials:

> While this richness of learner's material could mean that a "scribal school" was maintained at the building in which the tablets were found (…), it could just as well mean that some youngsters were educated in scribal schools "on the job," picking up the necessary literate arts as they worked.

Mathematical exercises in these texts took the form of building plans and surveys, student exercises in measurement and fantastic figures in the administrative documents (*ibid.*: 239). By examining the administrative evidence alone, Foster shows a mathematical curriculum at work in the Sargonic city of Girsu.

For southern Mesopotamia in the Old Babylonian period there is substantial evidence for the scribal curriculum in its elementary and advanced stages as described first by Robson (2001a) and then by Proust (2007, 2008) for Nippur, Robson for Larsa (as well as Kiš, see 2004a), and Robson (1999) and Friberg (2000) for Ur. Proust's discussion (2007) of Nippur mathematics and education is the most comprehensive of these three discussions, so that education and mathematics at Nippur can be used as a point of comparison to assess scribal formation and exercise throughout southern Mesopotamia in the early Old Babylonian period.

The purpose of this chapter is to show the early scribal educations that were utilized in the various economic milieu of the Old Babylonian kingdom of Larsa as well as the numerical systems that were used in the economic texts in order to present the various numerical and metrological environments in which rounding numbers could occur. The elementary education will be described, focusing on the use of sexagesimal place value notation (SPVN) and how this may be visible and may have been used in the economic texts. An initial brief description of the quantification systems will be followed by a discussion of elementary scribal education in the Old Babylonian period.

2.1 Systems of Quantification

The various metrological systems displayed in the economic texts already existed well before the Old Babylonian period. For example, the system of area measurement values had appeared by the proto-literate period of the late fourth millennium (Friberg 2007: 101). However, the very coherent Old Babylonian metrological system was the result of numerous reforms, beginning with Sargonic

reforms in the twenty-fourth century BCE and terminating with the Ur III period of the twenty-first century BCE.[1] What follows is a brief overview of these systems and how they corresponded to each other.

2.1.1 Measurement Systems

To start with, there were four fundamental metrological systems that developed over the course of the third millennium and were used in the Old Babylonian period: a capacity system, a weight system, an area and volume system and a length system. In addition, the area and volume system would be used to quantify bricks, with two variations, as described below. Measurement units are organized as found in the metrological table texts (for a catalog of this, see Appendix 3). The presentation below uses a hierarchical system of organization espoused by Friberg (1993). The smallest units appear on the right with larger units to the left. Left-facing arrows (⟵) present the factors which separate one unit from the previous one so that a chain of factors is expressed in each diagram. While each system is well established in the modern literature, examples from the texts studied here will be provided.

Units of Capacity (1 $\text{sila}_3 \approx 1$ l)
The capacity system appears in written documentation around 3000 BCE. Fundamental to this system, at least in Larsa during the Old Babylonian period, was the *gur* consisting of 5 *bariga* and 300 *sila*. This system was implemented by the Sargonic period, when alignment was made with the volume *sar* so that 1 *sar* volume was the equivalent of 60 *gur* capacity (Powell 1987–1990: 493). By the Old Babylonian period the system had developed as follows, incorporating the *gin* and *še* of the weight system as its lowest units:

$$\text{gur} \leftarrow \times 5 - \text{ bariga } \leftarrow \times 6 - \text{ban}_2 \leftarrow \times 10 - \text{sila}_3 \leftarrow \times 60 - \text{gin}_2 \leftarrow \times 180 - \text{še}$$

In the Old Babylonian period there are a variety of *sila* standard vessels, or objects used to measure the *sila*, including both a cubic *sila* with sides of roughly 6 *šusi* as well as a cylindrical *sila* with both a height as well as a diameter of 6 *šusi* (Friberg 2007: 101). The system for capacity, along with weight, is well attested in the texts studied here and used to describe grain (see for instance the grain storage bureau presented in Sect. 4.1), sesame (as capital in YBC 07473 and AO 06760, for instance), oil (AO 08464 lines 6 through 10, for instance), beer (AO 07034 lines 15 and 22, for instance), etc. Indeed, capacity is important in this period as the main

[1]For a discussion of these reforms and their ideological function, as well as an overview of how these reforms affected the accounting systems, see Powell (1987–1990). See below for their effect on the various metrological systems discussed here.

Table 2.1 Examples of texts with capacity measurement values

I. Text	II. Subject	III. Archive or bureau	IV. Scribe	V. Year	VI. Location
YBC 07473	Disbursement of goods evaluated in silver	Merchant intermediaries	*Itti-Sîn-milki*	*Rīm-Sîn* year 04	*Zarbilum*
AO 08464	Deliveries of goods evaluated in silver	Merchant intermediaries	*Itti-Sîn-milki*	*Rīm-Sîn* year 27	*Zarbilum*
YBC 04721	Grain disbursements	Bureau of irrigation and excavation	*Šamaš-aššu-aplu*	*Rīm-Sîn* year 01	Perhaps Larsa
AO 06760	Disbursement of goods evaluated in silver	Merchant intermediaries	*Ubār-Šamaš*	*Rīm-Sîn* year 02	Larsa
YBC 05494	Grain shipment	Grain storage bureau	Uncertain	*Rīm-Sîn* year 06	Larsa
AO 07034	Disbursement of goods evaluated in silver	Merchant intermediaries	Scribe G	*Rīm-Sîn* year 09	Larsa
LB 1097	Agricultural field preparation	Household	Uncertain	Uncertain	Perhaps Umma

means of evaluating grain which is, in turn, an important means to evaluate labor (Riftin 1937: no. 114; Riftin 1937: no. 116, for instance) in addition to its employment in agricultural production (LB 1097) (Table 2.1).

Capacity assesses an object by means of a container so that error can occur when residue is left behind in the vessel, or a dry measure can settle, reducing perceivable quantity within the container, etc. Such errors would appear as a loss or decrease in measurement value.

Units of Weight (1 $gu_2 \approx 30$ kg)
The weight system is probably one of the youngest systems, although '$gu_{2,}$' 'load' is decidedly old (Powell 1987–1990: 508) and can be understood as the amount that one man can carry. Notable for this system is the distinct separation of *gin*, *mana* and *gu* by factors of 60, while the relationship between *še* and *gin* can be understood as a factor of 180, that is, three sets of 60 or six sets of 30.

$$\text{gu}_2 \leftarrow \times 60 - \text{ma-na} \leftarrow \times 60 - \text{gin}_2 \leftarrow \times 180 - \text{še}$$

še and *gin* also constitute the lowest units of capacity as well as area and volume. Weight, along with capacity, is one of the most frequently attested metrological systems in the texts. It appears principally to quantify silver which, in this period, is one of the primary means used to assess capital.[2] Weight also appears for evaluating

[2]For instance YBC 07473 and AO 06760 capital sections.

Table 2.2 Examples of texts with weight measurement values

I. Text	II. Subject	III. Archive or bureau	IV. Scribe	V. Year	VI. Location
NBC 08014	Sales contract of gold assessed in silver	Merchant	*Ilšu-ibbišu*	*Sîn-Iddinam* year 06	Perhaps Larsa
YBC 07473	Disbursement of goods evaluated in silver	Merchant intermediaries	*Itti-Sîn-milki*	*Rīm-Sîn* year 04	*Zarbilum*
AO 08464	Deliveries of goods evaluated in silver	Merchant intermediaries	*Itti-Sîn-milki*	*Rīm-Sîn* year 27	*Zarbilum*
AO 06760	Disbursement of goods evaluated in silver	Merchant intermediaries	*Ubār-Šamaš*	*Rīm-Sîn* year 02	Larsa

gold (NBC 08014 line 2), wood (AO 08464 line 11–14), copper (AO 06760 line 13), tin (YBC 07473 line 43), etc. (Table 2.2).

Units of Areas and Volumes (1 sar $\approx$ 36 m^2/18 m^3)
The *iku*, *eše* and *bur* of the area system were already in use since the proto-literate period of the fourth millennium while the rest of the area system appeared by the Old Sumerian period of the middle of the third millennium (Friberg 2007: 116). Powell (1987–1990: 479) states of this early system, ‘the system shows traces of conscious manipulation to create unities that would facilitate mensuration and computation’. The area measurement *sar* is based on a square with a side of 1 *ninda*, while 1 *iku* (GAN_2) is 100 sar and based on a square plot of 1 *eše* sides (*ibid.*: 478).

$$\mathrm{GAN_2} \leftarrow \times 100 - \mathrm{sar} \leftarrow \times 60 - \mathrm{gin_2} \leftarrow \times 180 - \text{še}$$

A number of ‘aš’ signs typically precedes GAN_2 to quantify *iku* measurement values.

Volume is computed by multiplying area by 1 *kuš* so that exactly the same units make up volume *sar* as area *sar*. Høyrup (2002: 22) underlines that volume was understood as literally a ‘raised’ virtual height of an area. This system is well attested in the texts to assess both area (Ashm 1922-277, Ashm 1923-340 and LB 1097) and volume (NBC 11509, NBC 06763, YBC 12273 and LB 1097) (Table 2.3).

Units of Length (1 ninda $\approx$ 6 m)

The length system, used to measure length and width as well as height, is also a very old system. As Powell (1987–1990: 458) states, ‘most of the basic units were probably in existence by the early 3rd mill’. Some older units do appear in Old Babylonian mathematical texts but not in the metrological tables discussed below, such as *gi*, ‘reed’, the equivalent of 6 $kuš_3$ or 1/2 ninda, or $eše_2$, and ‘rope’, the equivalent of 10 ninda (Friberg 2007: 181).

$$\text{danna} \leftarrow \times 30 - \text{US} \leftarrow \times 60 - \text{ninda} \leftarrow \times 12 - \text{kuš}_3 \leftarrow \times 30 - \text{šu-si}$$

Table 2.3 Examples of texts with area or volume measurement values

I. Text	II. Subject	III. Archive or bureau	IV. Scribe	V. Year	VI. Location
NBC 11509	Excavations	Bureau of irrigation and excavation	Scribe I	*Rīm-Sîn* year 31?	Perhaps Larsa
NBC 06763	Excavations	Bureau of irrigation and excavation	*Immer-ilī*	*Rīm-Sîn* year 38	Perhaps Larsa
Ashm 1922-277	Grain production	Grain production archive	Scribe P	*Hammu-rābi* year 35	Ur or Larsa
Ashm 1923-340	Grain production	Grain production archive	Scribe P	*Hammu-rābi* year 35	Ur or Larsa
YBC 12273	Excavations and labor	Bureau of irrigation and excavation	Scribe Q	*Hammu-rābi* year 38	Perhaps Larsa
Ashm 1922-290	Excavations	Bureau of irrigation and excavation	Uncertain	Uncertain	Perhaps Larsa
LB 1097	Agricultural field preparation	household	Uncertain	Uncertain	Perhaps Umma

Bricks (1 sar ≈ 720 bricks)
The brick system, called 'brickage' here, was possibly a development of Sargonic period reforms and is expressed using area measurement values (Powell 1987–1990: 490–491). Building on the work of Scheil (1918: 162), François Thureau-Dangin established the makeup of this system. Brickage is an accounting system that is expressed metrologically in the same manner as both area and volume, in which 12 sixties of bricks, or 720 bricks, is equivalent to 1 *sar* of bricks (Thureau-Dangin 1932: 192 note 1). Brickage is described by Neugebauer as 12 bricks in one brick *gin*, 12:0 (720) bricks in one brick *sar*, 10:0:0 (36,000) in one brick *ubu* and 20:0:0 (72,000) bricks in one brick *iku*.[3] Proof of this in the mathematical texts is given through YBC 04607 Problem 6, where the brick quantity 1 *sar* 2 × 60 + 24 appears, 'from which it follows that 1 SAR is the equivalent of 12,0 bricks' (*ibid.*: 94). In Middeke-Conlin (forthcoming c: Appendix A.6), the lowest unit in this system is suggested to be the type of brick being quantified:

$$\mathrm{GAN}_2 \leftarrow \times 100 - \mathrm{sar} \leftarrow \times 60 - \mathrm{gin}_2 \leftarrow \times 12 - \mathrm{brick\,type}$$

As pointed out in Middeke-Conlin (*ibid.*), a variation of this system existed in the Old Babylonian period that was used to quantify brick deliveries. In this system, 60 bricks are in 1 *gin*, while 12 *gin* are in 1 *sar*:

$$\mathrm{GAN}_2 \leftarrow \times 100 - sar \leftarrow \times 12 - gin \leftarrow \times 60 - \mathrm{brick\,type}$$

[3] Following Neugebauer's expression of magnitude as shown in Neugebauer and Sachs (1945: 5).

2.1.2 *Bridges and Other Connections Between Metrological Systems*

These systems were connected by means of what can be termed 'bridges'. As understood here, bridges connect systems through computation. Connection is made by means of multiplication where 1(unit of measure$_1$) multiplied by 1(unit of measure$_2$) produced 1(unit of measure$_3$). Systems connected through this are length and surface, and then surface, height and volume.

In the metrological tables discussed below, length and width are presented in one table while height appears in another. Thus, 1 *ninda*, a unit of length, transformed to 1 in SPVN (see below for a description of SPVN) while 1 *kuš*, a unit of height, transformed to 1 in SPVN and 1 *ninda*, a unit of height, transformed to 12 in SPVN. This is because 1 square *sar* has sides of 1 *ninda* so that 1 *ninda* multiplied by 1 *ninda* is equal to 1 *sar* (*ibid.*: 479), while to produce 1 *sar* volume out of 1 *sar* area, one multiplied by 1 *kuš*, not 1 *ninda* (*ibid.*: 490). Thus, 1 *sar* area multiplied by 1 *kuš* height produced 1 *sar* volume. This same 1 *sar* area multiplied by 1 *ninda* height produced 12 *sar* volume. A *sar* volume was conceived as a rectangular prism with a base of 1 *sar* (see Proust forthcoming, for further details). This is evident, for instance, in NBC 11509, a text produced by scribe I and dated to the middle of *Rīm-Sîn*'s reign, in which the volume of earth to be excavated for construction of a canal is estimated. In lines one through seven, length (column 1), width (column 2) and depth (column 3) produce volume (column 4). The bridges can be summed up as follows:

- between length and area:
  - 1 *sar* area = 1 *ninda* × 1 *ninda*
- between surfaces and volumes:
  - 1 *sar* volume = 1 *sar* area × 1 *kuš*
  - 1 *gin* volume = 1 *gin* area × 1 *kuš*
  - and so on.

In addition to the various bridges, several other connections exist between metrological systems. First, *mana*, *sila* and *sar* are all divided into *gin* or units of 60. For instance, *gin* is used to represent weight throughout YBC 04224, which is attributed to the scribe A, dated to the reign of *Gungunum* of Larsa, and is from the city of Larsa or its environs. *Gin* is used to represent capacity in AO 08464, line 9, a list stating deliveries of various goods evaluated in silver that is attributed to *Itti-Sîn-milki* of *Zarbilum* and dated to *Rīm-Sîn*'s twenty-seventh year in office. Finally, *gin* is used with volume in lines 3 and 8 of NBC 11509 just mentioned above.

Second, as Powell (1987–1990: 490) notes in summing up the various metrological systems, capacity and volume are linked as well. There is 1 × 60 *gur* capacity in 1 *sar* volume while 1 *gin* volume contains 1 *gur* capacity. Powell (*ibid.*: 493) suggests a reason for this. Describing Old Akkadian reforms, he states:

> Introduction of the Akkad gur is associated with a rationalization of the metrological system, which seems to consist primarily of the following: (1) abandonment of such archaic phenomena as distinct norms for liquid vs. dry capacity and distinct minas to weigh wool or cloth vs. metal; (2) establishment of a rational relationship between the mina and the sila (probably 2 minas of water = 1 sila); (3) introduction of the volume s/šar defined as 60 gur of capacity; (4) introduction of a new gur composed of 5 bariga to provide the basis for these linkages. General adjustment of norms probably accompanied this reform, but direct evidence is lacking.[4]

These connections can be summed up as follows:

- Capacity, weight, area:
  - *sila*, *mana* and *sar* are all divided into 60 s of *gin*
- Volume and capacity:
  - a cube with 6 *šusi* edge has a capacity of 1 *sila*
  - 1 *gin* volume has a capacity of 1 *gur*
  - 1 *sar* volume has a capacity of 1 × 60 *gur*.

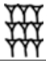
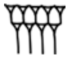
2.1.3 Numerical Systems

The discussion above is very simplified. Most measurement values as seen on the lists discussed below and in Appendix 3 have three parts: a numerical value, which can consist of both an integer number and a fraction, appears before a measurement unit which is then followed by a lexeme signifying the nature of the quantified item, that is, capacity, weight, area, etc. (Proust 2009: Sect. 3.3, esp. 3.3.6 through 3.3.8). For example, '1(diš) še ku_3-babbar' exhibits all three elements: '1(diš)' is the numerical value, 'še' is the measurement unit, and 'ku_3-babbar' the lexeme. In some cases, such as the *bariga* or *ban* of the capacity system, the numerical value and measurement unit seem to be represented by the same symbol so that 1(ban_2) as well as 1(bariga) represent a numerical value and a measurement unit at the same time (*ibid.*: Sect. 3.4).

Further, there are two common systems to express integer numbers. The most common is an additive decimal system where a vertical wedge, the 'diš' sign, expresses 1 through 9, while a '*winkelhaken*,' the 'u' sign, has a numerical value of 10. Thus, 1(u) is added to 1(diš) to produce 11. To express 1 through 59, a scribe

[4]This is further underlined on p. 497: 'Introduction of the Akkad Gur is related to a redefinition of the system of volume measure (…) to permit expression of volume and capacity as the equivalent of unities.' Further mention is made on p. 508, 'The Akkad reform, evident especially in the volume system (…), seems also to have linked the weight system to the systems of volume and capacity via the definition: 2 minas = 1 sila water. This relationship is based on the definition of the sila as the cube of 1/60 nindan (216 cubic fingers)'.

Table 2.4 Comparison of normalized and non-normalized numbers

Number	Normalized	Non-normalized
4		
7		
9		
30		
40		
50		

would need to write the ‘diš’ and ‘u’ signs as often as necessary.[5] Metrological systems that use this additive system are: *gin* and *sila* for capacity; *še*, *gin* and *mana* for weight; *sar* for area; and *šusi*, *kuš*, *ninda*, UŠ and *danna* for lengths.

In the mathematical texts, ‘u’ and ‘diš’ will appear in up to two rows for ‘u’ and three rows for ‘diš’ with up to three wedges per row, so that to write 50, that is 5(u), a scribe would produce an upper row of three *winkelhaken* and a lower row of two, while to write 9, that is 9(diš), a scribe would write three rows with three wedges apiece. This system is called ‘normalized.’ As Oelsner (2001) points out, this is a later development; earlier texts tended to state numbers in two rows with up to five diš-wedges in the upper row and four diš-wedges in the lower row. This is called ‘non-normalized’. The numbers 4, written 4(diš), and 40, written 4(u), display an important distinction: in normalized script both appear as three wedges in an upper row and one wedge in a lower row, while in non-normalized script they appear in two rows of two wedges[6] (Table 2.4).

Fractions also appear as numerical values. Indeed, as stated by Proust (2007: 69), only *mana*, *ninda* and *danna* required 1 through 59 to express values. Otherwise, the range of arithmograms that occur as whole numbers before measurement units in the metrological lists from Nippur and elsewhere appears as follows (Table 2.5)[7]:

---

[5]This notation is well known to modern scholars. See Proust (2009: Sect. 3.2.2 and 3.2.3) for a relatively recent discussion of it. See also Appendix 3 for a summary of metrological lists and tables of capacity, weight, area and length that exhibit this system of notation.

[6]‘4’ is used by Oelsner (2001: 54) as an example of dating by number shape: ‘Bezeugt sind für die genannten Zahlen zwei Schreibweisen: einmal eine ältere in zwei Reihen (bei „4" zweimal zwei Keile nebeneinander), zum anderen eine später vorherrschende, bei der „7-9" in drei Reihen mit maximal drei Eindrücken geschrieben werden, bei „4" wird der vierte Keil unter die drei der oberen Reihe gesetzt’.

[7]Modified from Proust (2007: 69). For Larsa, see Robson (2004b: 19–24). The available evidence from Larsa, although not as complete as that from Nippur, shows that a similar if not the same system was probably taught in schools in Larsa. See below Sect. 2.2.2 and Appendix 3

Table 2.5 Measurement units and associated whole numbers

Measurement unit	Whole numbers
gin$_2$	1–19
sila$_3$	1–9
še	1–29
sar	1–49
šu-ši	1–9
kuš$_3$	1–5
UŠ	1–14

Table 2.6 Fraction signs

Fraction	Sign
1/3	
1/2	
2/3	
5/6	

Fractions are used in the metrological lists instead of some numbers so that a fraction of a larger measurement unit is used to express whole numbers of a smaller measurement unit, for instance 1/3 *mana* in place of 20 *gin*. Most fractions in the metrological lists had a special sign to represent them: 1/3, 1/2, 2/3, 5/6. However, two in the metrological lists did not: one-6th, written igi 6(diš)-gal$_2$ and one-4th written igi 4(diš)-gal$_2$ (*ibid.*: 69–70).

Here, to represent this system of notation and maintain transparency, fractions written using a special sign, such as those in Table 2.6, will be translated using modern fractional notations like 1/3 or 1/2. Fractions written using the formula 'igi *n*-number-gal$_2$', such as igi 4(diš)-gal$_2$' will be translated as 'one + *n*-ordinal number', or 'one-4th', using the example just provided rather than using modern fractional notation (such as 1/4).

Counting Larger Measurement Values and Discreet Objects

To quantify larger measurement values, three systems are used: system S and system G as well as a centesimal system. System S (for sexagesimal), an additive system based on a sexagesimal structure, is one of the oldest extant systems dating to the late fourth millennium (Damerow and Englund 1987: 127–165; Nissen, Damerow and Englund 1993: 28) and is used with gu$_2$ and gur measurement values.[8]

[8]See Friberg (2007: 373–374) for a summary of this system and its historical development. See also Proust (2007: 70 and 2009: Fig. 3). Note that Chambon and Robson (2011) transliterate the largest unit as šar$_2$-gal šu nu-gi$_4$ with gi$_4$, which they translate as 'return' or 'repeat'. This would imply that this value does not actually exist in this system.

$$\text{šar}_2\text{-gal šu nu-tag} \leftarrow \times 60 - \text{šar}_2\text{-gal} \leftarrow \times 6 - \text{šar}'\text{u} \leftarrow \times 10 - \text{šar}_2 \leftarrow \times 6 - \text{geš}'\text{u} \leftarrow \times 10 \\ - \text{geš}_2 \leftarrow \times 6 - \text{u} \leftarrow \times 10 - \text{aš/diš}$$

System S is also used for discrete objects such as animals, persons, etc. (See, for instance AO 08464, lines 17 through 26 for animals and Riftin 1937: no. 115 for persons). At the lowest levels, these cardinal numbers use the additive decimal system as outlined above to quantify whole numbers from 1 to 59. The aš sign () is typically used as the lowest element with measurement values, while the diš sign () often appears to count discrete items. Sixties, when counting discrete objects, appear typically as a quantity of šu-ši (translated 'sixties'), although they can often appear as simply geš$_2$ in the administrative corpus as well. geš$_2$ (), however, appears nearly indistinguishable from the diš sign in all but size.

System G (for GANA) is also an additive system but with a partially sexagesimal structure.[9] It is typically used to quantify area and then volume and brick measurement values (see especially Friberg (2001: 68, 69–70) and then Friberg (2007: 378) for a historical development of this system).

$$\text{šar}_2\text{-gal šu nu-tag} \leftarrow \times 60 - \text{šar}_2\text{-gal} \leftarrow \times 6 - \text{šar}'\text{u} \leftarrow \times 10 - \text{šar}_2 \leftarrow \times 6 \\ - \text{bur }'\text{u} \leftarrow \times 10 - \text{bur}_3 \leftarrow \times 3 - \text{eše}_3 \leftarrow \times 6 - \text{aš} \leftarrow \times 2 - \text{ubu}$$

The aš sign appears in this system as well to quantify *iku* measurement values, so that an *ubu* is one half of an *iku* or 50 *sar*.

Another system for quantifying discrete objects combines system S with a centesimal system to count tens, sixties, hundreds and thousands and is evident in Ashm 1922-281, Riftin 1937: no. 114 and Riftin 1937: no. 116. This system presents numbers 1 to 99 using system S. Thus 1 to 59 uses the additive system described above, with 60 appearing as 1(geš$_2$) and then 61–99 as 1(geš$_2$) and the numbers 1–39 again. However, hundreds are expressed with a quantity of 1(diš) to 9(diš) followed by the sign 'me' while thousands are represented by the quantities 1 (diš) to possibly 9(diš) representing 1000. For clarity, thousands are transliterated as 'lim' in the present volume. Line 5, column 2 of Riftin 1937: no. 116 is representative of this system. In this text, 1(lim) 8(diš) me 1(geš$_2$) 3(u) 4(diš) translates to $1 \times 1000 + 8$ hundred $1 \times 60 + 34$ or 1894 in the modern base 10.

Interestingly, in Ashm 1922-281, when calculating men or man-days of labor, the total in lines 32 and 33 is presented in system S while each individual quantity of men in lines 1 through 31 used to produce this total is represented in centesimal notation. For instance, in line 10, 1(diš) me 1(geš$_2$) 2(u) 1(diš), or $100 + 1 \times 60 + 21$ appears, while the total in lines 32 and 33 is given as 8(geš$_2$) 5(u) 9(diš) or $8 \times 60 + 59$.

[9]This system was already known to scholars in 1900 with Thureau-Dangin's publication (1900) on volume measures.

Proust (2002) has shown that this system, while exceptional for southern Babylonia at this time, was the basis for mathematics at Mari in northern Mesopotamia.[10] Indeed, the example from Riftin 1937: no. 116 quoted above can be compared to M 7857 from Mari, where the left column states a quantity in system S while the right column states it in the system outlined above. Line 4 of the obverse of M 7857 is emblematic: '$20 \times 60^2 + 2 \times 60 + 51$ // 7 gal 2 *li-im* 1 me $1 \times 60 + 11$' both translate to 72,171 in modern base 10. It is then an additive system with place values for 100 (me), 1000 (li-im) and 10,000 (gal):

$$\text{gal} \leftarrow \times 10 - \text{lim} \leftarrow \times 10 - \text{me}$$

However, the centesimal system uses system S for 1–99. The centesimal system is also present in PTS 247, an Old Babylonian mathematical text that may have been used for practice in translating between base 60 and the centesimal system (see Appendix 1.B). The word 'translate' is used in this context to denote a change in numerical expression, not to be mistaken for a change in numerical or measurement value, nor to be understood as a modern translation of a text.

Sexagesimal Place Value Notation

Sexagesimal place value notation, abbreviated to SPVN, can also be described as an additive decimal system that appears as a string of normalized numbers below sixty, that is 1 through 59, in successive places, without recourse to zero. 1 would be written as '1(diš)', 10 as '1(u)', 59 as '5(u) 9(diš), while the number following 59 would be written as '1(diš)' again, not 1(geš$_2$) to denote the value '60' as in system S described above. In translation and interpretation, a colon is used to separate numbers in a single string in order to highlight the sexagesimal nature of this system. Thus, a string like 2(diš) 1(u) 4(diš) 1(diš) 4(u) could be normalized here as 2:14:1:40.[11]

SPVN was used only in multiplication and division by means of multiplication by a number's reciprocal. It was never used to carry out a solely additive or subtractive operation. If SPVN was added or subtracted, this was only as a part of an algorithm of which multiplication was an important operation. With this system, measurement values were transformed to an SPVN number before multiplication and then transformed from SPVN to a measurement value after the calculation was complete. For instance, in IM 57828, a square field with sides of 1/3 *kuš* 1/2 *šusi* lengths produces an area of 9 one-5th of a 3rd *še* as follows:

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[10]See also IM 81438 from Fara in Biggs and Postgate (1978: 106–107 and 112), which is possibly the earliest example of a similar system. See, for instance, the total on the reverse: 1(u) 3(aš) ⸢*li*⸣-*im* 9(aš) mi-at 1(geš$_2$) 1(u) 2(diš).

[11]Or 2:10:4:1:40, depending on the calculation in which this number was used. Indeed, only a stated calculation or the results of the calculation can show how this number was understood by the person who produced it. Thus, it is important to understand that the purpose of a transcription is to state the numbers as seen in the text, while the purpose of a translation is to show how these numbers were used in calculation.

1/3 *kuš* 1/2 *šusi* → 1:45
1:45 × 1:45 = 3:3:45
3:3:45 → 9 one-5th of a 3rd *še*

It should be remembered here that arrows (→) are used to denote the direction of transformation, whether to SPVN or to measurement value. 1/3 *kuš* 1/2 *šusi* transforms to 1:45, which produces 3:3:45 when multiplied by itself. This number then transforms to 9 one-5th of a 3rd *še*.[12] Once an actor was familiar with it, SPVN made multiplication between dissimilar systems easier, such as the multiplication of lengths to produce the area of a field as seen in the above example.

An important aspect of the present study is how SPVN is viewed. While SPVN is, as its name indicates, a place value system, it lacked any implication of absolute order or magnitude. Thus, magnitude was not expressed by the ancient scribes.[13] Written '1(diš)' could represent 1, 1:0 or 1:0:0 when magnitude was represented, that is, 1, 60, 3600 and so on in modern base 10. Because of the floating nature of numbers, it is anachronistic and often counterproductive to state an absolute value when interpreting calculations in SPVN. This is not how they were represented by the scribes. By doing this and artificially imposing an absolute value on computations, similarities in calculation can be missed. These similarities were probably important to the ancient scribes who compiled the mathematical curriculum. Thus, attempts to represent magnitude when interpreting texts in the present volume are only made very rarely and hesitantly. Magnitude is and was typically only represented by transforming from or to measurement values before and after calculation. The only exception is a '0' between numbers in a modern interpretation when it is deemed important to represent magnitude for modern readers, such as the appearance of SPVN 14:0:8:12 in the discussion of YBC 04224 in Sect. 6.1.

SPVN is not attested until probably the Ur III period.[14] In this period, as Ouyang and Proust (forthcoming) show, two varieties of place value notation were used: partial-SPVN systems used for subtraction and perhaps addition as well, and SPVN used for multiplication. According to Ouyang and Proust, partial-SPVN describes systems of notation which are either partly sexagesimal, partly positional, or partly sexagesimal and partly positional at the same time. By the Old Babylonian period, the metrological systems had been fully adapted to work with and transform to and from SPVN (Friberg 2007: 101).

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[12]This process of transformation is summarized very well in Proust (2007: 249–251), see especially Fig. 20.

[13]See Proust (2009: Sect. 4) on this. In Sect. 4.2 it is stated: 'positional numbers are written without any indication of their order of magnitude (that is, 1, 60 and 60^2 are written in the same way). Second, positional numbers are not associated with a unit of measure or any quantified item (such as magnitude, commodity or collection)'. Further, Proust (*ibid*.: note 32) states: 'the same numbers appear repeatedly in the right column of metrological tables. For scribes, reading metrological tables from left column to right column is easy, but reading them from right to left column requires a mental control over the orders of magnitude'.

[14]See Powell (1976) for a 'scratch pad' firmly dated to the fifth year of *Amar-Sîn*'s reign.

Ordinal Numbers

Ordinal numbers that act like cardinal numbers also appear in some texts studied here. This is evident in LB 2053, written by an unknown author designated here as scribe K, probably around the thirty-fourth year of the reign of *Rīm-Sîn* of Larsa and describing agricultural costs in terms of bran. It is also evident in AO 08461, which describes grain rations and was also written by an unnamed author designated here as scribe N, who was active around Larsa.

Typically, an ordinal number is formed by appending a genitive '–k' followed by the copula [am] to a number and is understood as 'it is of x-number' (Edzard 2003: 67). This is true for any ordered item. It is very common in date formulas where the simple statement 'u_4 number-kam' is used to indicate the day the text was produced. 'u_4 4(diš)-kam' in YBC 04265 line 16 is literally 'it is of day 4' or 'the 4th day'.

Thus, LB 2053 line 3 reads 'u_4 1(u) 7(diš)-kam', an ordinal number, which should mean 'it is of day 17' or 'the 17th day'. However, like all numbers constructed in this manner in LB 2053, it is used to enumerate a number of days. The same can be said of months in LB 2053. This is confirmed when the days are added up and then compared with line 12. In line 12 a total of days and months is stated: '*ša* iti 2(diš)-kam u_3 u_4 5(diš)-kam,' translated 'which is of 2 months and 5 days'. Perhaps, then, line 17 can be understood as literally 'it is of 17 days' rather than 'it is of day 17' as it is typically understood. Thus, it would represent 17 days rather than day 17.

2.2 Elementary Education in the Old Babylonian Period

The various numerical and metrological systems just outlined, and how they fit together and could be manipulated, were presented in what is now called the elementary scribal education. For southern Babylonia, this education is well attested at Nippur, as described by Proust (2007), and visible in places like Larsa and Ur, and elsewhere. This education is attested at Larsa with texts published in Robson (2004b). It is suggested at Ur with texts published in Robson (1999) and studied by Friberg (2000). Moreover, the Schøyen collection published by Friberg (2007: 45–126) suggests even greater prevalence of this educational system, although because this collection is unprovenanced it is not fully examined in the present volume. This is not the place for a complete discussion of elementary education throughout Mesopotamia in the early Old Babylonian period. Indeed, the elementary education has already been well described for the sources currently available. The discussion here is limited to a short synopsis of elementary education, and how this education affected economic environments by exploring the use of rounding. In this way, the numerical systems as they were understood by the ancient scribes can be examined and their use in the administrative environment more easily explained.

2.2.1 Tablet Types

To begin with, it is important to understand the basic features of the evidence of this education. This evidence is found on clay tablets that often differ in shape and style from tablets on which economic texts are found. Four types of tablets are described by Civil et al. (1979: 5–7; 1995: 2308) for the city of Nippur and were used by Veldhuis (1997) and many others, including Robson (2001a) and Proust (2007), to reconstruct the elementary education within this city in particular. These tablet types are conveniently named type I, type II, type III and type IV by modern scholars and will be referred to as such in this study. The four types of tablets function in different ways and often have different content. In addition, type M and type S tablets are also described by Proust (2007: 90–163) among others, following Tinney's discussion (1999: 160) of literary texts. Type M and type S tablets are not investigated in the present study. Instead, this study examines the shapes of tablet types I through IV and their prevalence outside of Nippur, in the cities of Ur and Larsa, in order to illustrate the range of tablet shape and content beyond Nippur.

Most texts studied here are of uncertain provenance and are thus only suggested as deriving from the city of Larsa. For instance, while Robson (2004a) suggests Larsa as provenance for texts that she published, this is not assured because texts housed in the Ashmolean museum, like those from Yale (such as YBC 11924) or the Louvre (such as AO 08865), were generally purchased on the antiquities market or resulted from unscientific digs. Moreover, the tablet AO 08865 is examined in Proust's (2005) article, where doubt is cast on the provenance to the city of Larsa suggested by Thureau-Dangin (1930: 73). Thus, Robson's and Thureau-Dangin's designations of provenance to Larsa are followed here, but with some hesitation.

Type I tablets are large, multi-columned tablets with between two and six columns on each side. These tablets, as well as prisms, were inscribed with lists containing several hundred lines of text. In so far as mathematics at Nippur are concerned, these texts consisted entirely or largely of metrological lists, metrological tables or numerical tables. As Robson (2001b: 46) has pointed out concerning type I texts, they represent an entire composition, whether metrological or numerical series, or a significant part of it. Their purpose was to present a text as already learned by a scribe. Veldhuis (1997: 31) suggests that these texts,

> may have been produced for special occasions, for instance as a kind of examination, which would also account for their relative rarity. Prisms and type I tablets were inscribed by advanced students. This may be concluded from the writing, which is usually careful. This is even true of those prisms which contain elementary exercises…

This hypothesis, that type I tablets and prisms present a kind of examination or were produced for another particular purpose, is followed here. Proust (2007: 84) notes that only one fragment of a prism housed in Istanbul today is attributed to Nippur, NI 4908, the majority being type I tablets like NI 2733 or fragments like NI 10219.

The extant documents from Larsa examined in the present study are type I tablets and prisms, perhaps referring to two different schools within the city if AO 08865 and Ashm 1923-366 are from the city of Larsa. Another possibility would be

Table 2.7 Courses 1 and 2 at Larsa

Museum number	Tablet type	Contents
Course 1		
AO 08865	Prism	Combined table of length, height?, square roots, cube roots
Ashm 1923-366	Prism	Combined table of length, height, square roots, cube roots
Course 2		
BM 92698	Type I	Standard table of squares, square and cube roots
IM 73365	Type I	Multiplication, ×40, broken
IM 73381	Type I?	Multiplication, ×25, ×22:30, ×20, broken

that two different levels of education are exhibited on these documents, one dealing with metrological tables (and possibly lists) and another with numerical tables. For simplicity's sake these two hypothetical courses are referred to here as course 1 which deals with metrological tables (and possibly lists as well) and then numerical tables, and course 2 which presents numerical tables only. Course 1 appears on prisms while course 2 appears on type I tablets (Table 2.7).

At Ur, there are only two extant type I tablets. The shape of both is similar, although UET 7, 114 has two columns on each side and UET 7, 115 has three columns per side. Content from Larsa and Ur is similar to that found at Nippur. However, no text from either Larsa or Ur offers a complete table. Tables of multiplication, such as IM 73381, are in decreasing order, where, for instance, multiplication by 25 precedes multiplication by 22:30, which in turn precedes multiplication by 20.

Type II tablets are of variable size with typically unrelated texts inscribed on both sides. On the obverse, two or three large columns appear with the same extract of a list or composition written in each column. The left-hand column shows a more competent hand than the right-hand columns, which often appear unskilled and are separated from the left by a double ruling. In many cases the right columns were clearly erased several times and overwritten. These texts probably represent exercises being learned by an aspiring scribe, where the aspiring scribe copies the hand of a master. The aspiring scribe is learning how a text or system works and should look, based on the teacher's example. At Nippur, the reverse typically holds a different text from the obverse and is probably the repetition of a previously learned text (Veldhuis 1997: 35–6). Thus, a text which is being learned and a text that is being reviewed are both present on type II texts.

This ordering of texts is used first by Veldhuis (*ibid.*) with lexical texts and then Proust (2007) with mathematical texts to establish the order in which texts were memorized in the course of the scribal education at Nippur.[15] Indeed, it is through

[15]Regarding type II tablets, Veldhuis (1997: 35) states: 'The reverse exercise of a type II tablet was generally a repetition of a school text previously studied. That this was the case may be concluded from an analysis of obverse/reverse correlations. Nippur type II tablets carrying an extract from a thematic list on the obverse often carry an elementary exercise on the reverse. Advanced exercises such as proverbs or model contracts on the obverse often go with a thematic list on the reverse.

these texts that we can ascertain the order in which a scribal curriculum was presented to students. Only two type II tablets, both published by Robson,[16] could be located outside Nippur with relative certainty. These fragmentary texts allow for a very tentative suggestion that the scribal curriculum at Larsa was presented in the same order as that found at Nippur.[17]

Type III tablets are small, elongated, single column texts inscribed with extracts of the larger texts seen on type I tablets. The lengths of the extracts found on these texts are generally the same length as extracts found on the obverse of type II exercise tablets, while the quality of writing suggests they are the products of students (Veldhuis 1997: 38). Typically, at Nippur, they present eight to fifteen lines of a metrological table or a complete numerical table (Proust 2007: 88). This means that the extracts in type III texts were probably already presented by the instructor on type II tablets and are being reviewed by the aspiring scribe. At Nippur they are named im-gid$_2$-da, translated ‘long tablet’, a term that frequently appears on Old Babylonian texts of the same size and shape, and is often followed by a name, presumably though not certainly, that of the text’s author. While extracts of metrological texts appear in these texts, most of them present numerical tables (*ibid.*: 88–9).

Texts from Larsa are very similar in content: three are metrological tables while the remaining nine are numerical tables, typically multiplication tables. Variation appears, however, in the colophons. As at Nippur, im-gid$_2$-da, ‘long tablet’, appears followed by a person’s name, *Bēlānum* on one tablet and *Sîn-apil-Urim* on four tablets. In addition, dates appear on five tablets. One tablet lists only a day, three tablets list the day and month, while one tablet lists the day, month and year (*Rīm-Sîn* year four).

Two courses are again suggested here, based on these colophons, which reinforces the distinction suggested above between two schools or two levels of education at Larsa for type I tablets and prisms. Tablets associated here with course 2 all carry the description im-gid$_2$-da tablets or long tablets and are qualified by a person’s name. Often, though not always, this is followed by a date formula and, in two exemplars, a doxology. Tablets associated with course 1 typically lack this, although in one text a day is mentioned (Table 2.8).

Type IV tablets are typically round or square shaped exercise tablets that are small enough to hold in one hand. Lexical texts often feature between two and four lines. The teacher’s work is on one side and the student’s work on the other (Veldhuis 1997: 38). Few texts from the elementary phase of scribal education appear on these tablets and are almost all exercises in calculation (Proust 2007: 90). Mathematical texts at Nippur, often written on a square tablet, feature problems and

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This corresponds to a rough curricular order: elementary exercises—thematic lists—advanced exercises’.

[16]Ashm 1932-526n (Robson 2004b: 23–24) and Ashm 1933-180 (Robson 2004b: 24).

[17]Cf. Proust (2007: 85–87) for these texts.

Table 2.8 Type III tablets by course at Larsa

Museum number	im-gid$_2$-da	Personal name	Month	Day	Year	Doxology	Content
Course 1							
Ashm 1923-318	NA	NA	NA	NA	NA	NA	×8
Ashm 1923-410	NA	NA	NA	27	NA	NA	Table of weights
Ashm 1923-414	NA	NA	NA	NA	NA	NA	Table of area
Ashm 1924-450	NA	NA	NA	NA	NA	NA	×12
Ashm 1924-457	NA	NA	NA	NA	NA	NA	×7:12
BM 92680	NA	NA	NA	NA	NA	NA	Table squares, square and cube roots
Plimpton 317	NA	NA	NA	NA	NA	NA	Table of weights
Course 2							
Ashm 1922-178	yes	*Bēlānum*	7	12	NA	NA	×25 × 20
Ashm 1924-447	yes	*Sîn-apil-Urim*	12	9	NA	Praise Nisaba, Ea	×24
Ashm 1924-451	yes	*Sîn-apil-Urim*	12	13	NA	Praise Nisaba	×24
Ashm 1924-472	yes	*Sîn-apil-Urim*	NA	NA	NA	NA	×10
YBC 11924	yes	*Sîn-apil-Urim*	6	11	*Rīm-Sîn* year 04	NA	×4

answers inscribed on the lower right-hand corner with computation in SPVN in the upper left-hand corner.

Type IV tablets from Ur are typically lenticular in shape with proverbs on the obverse and numerical exercises often on the reverse, including many in a tabular form or layout. Stated problems are notably missing.[18] A text from Larsa published by Robson[19] is also lenticular, in this case with a trapezoidal diagram on the obverse and many partially erased numbers in SPVN. This text lacks a stated problem as well. While these texts do not state problems, it is safe to assume, as Friberg (2000) does for texts from Ur, that they did refer to problems found within

[18]Tablets from the Old Babylonian city of Ur have been studied by Robson (1999: 245–272) and Friberg (2000). See also Appendix 3.

[19]Ashm 1922-168 (Robson 2004a: 18–19).

the scribal curriculum, and that these problems are representative of a common computational culture in Southern Mesopotamia. Thus, texts from Nippur can provide evidence for problems that were probably used at Ur.

It is clear that mathematical tablets from the Old Babylonian period varied according to location. At Larsa both prisms and type I tablets appear, whereas a typical multi-columned type I tablet is found at Nippur and Ur. Evidence for type II tablets outside of Nippur is sparse, although the two fragments from Larsa suggest similar appearance and use to the tablets from Nippur. Type III tablets from Nippur and Larsa are very similar, while there is no evidence of such tablets from the city of Ur. However, within Larsa there are variations in the colophon. Type IV tablets from Ur and Larsa differ significantly in content and shape from the typical tablet from Nippur. At Ur and Larsa, extant tablets are typically lenticular in shape as opposed to square shaped at Nippur. The sole text from Larsa exhibited a diagram and numbers in SPVN. Ur texts tended to be tabular in form or layout. At both Larsa and Ur, problems were not written on type IV tablets while at Nippur problems, answers and solutions appear in the texts themselves.

For the city of Larsa in particular the shape of an elementary curriculum can be discerned. At the beginning of this section it was suggested that there were either two schools or two levels of education within this center, initially based on the distinction between type I tablets and prisms, labelled here course 1 and course 2. Course 1 tended toward prisms and incorporated metrological exercises as well as square roots and cube roots, while course 2 tended to consist of type I tablets and focused on numerical exercises, chiefly multiplications. Two type II tablets exist, at least one of which suggests that lists of capacity were learned in tandem with the list of trees and woods. Type III tablets bore a similar distinction between courses as type I tablets and offered further refinement. Course 1 consisted of tables of weight and area, as well as tables of multiplication, and then tables of squares, square roots and cube roots, while the tablets themselves lacked colophons or the colophon was very sparse. Course 2 only afforded evidence for multiplication tables while colophons were rich, often containing the word 'im-gid$_2$-da', 'long tablet', a person's name, a date and occasionally a doxology. Based on tablet shape, perhaps all type III tablets come from the same scribal center: pinched corners when visible, ruled lines and a tendency for lines to curve upward from left to right, even if this is only visible on the final ruling and line. This is not conclusive, however. Finally, at least one text, Ashm 1922-168, presents a geometric exercise found on a lenticular tablet, providing evidence of an advanced education.

Thus, elementary and advanced phases of education are present at Larsa. Because course 1 shows signs of a complete elementary curriculum—metrological tables as well as numerical tables of multiplication, squares and roots—while course 2 is limited to numerical tables, it is suggested here that there are two different schools represented in the texts from Larsa. The use of prisms in course 1 as opposed to type I tablets in course 2 reinforces this distinction between schools, if the prisms do indeed belong to course 1 as hypothesized here. Perhaps, then, the two type II tablets and one lenticular type IV tablet can be connected to course 1 as well.

Under this hypothesis, the students of course 1 would have received a full elementary education in which they memorized both metrological and numerical tables. At the conclusion of each unit, the students produced prisms on which the full metrological and/or numerical lists and tables were written out from memory by the aspiring scribe. Some went on to an advanced education in a classroom environment, as hinted at by the one type IV text attributed to this school. Others may have gone on to a professional education. Students of course 2 may have received an early elementary education with course 1, or this phase of education is simply missing. Focus in course 2 was on numerical tables that would aid calculation. At the conclusion of each unit, students wrote out numerical tables from memory on a type I tablet rather than on a prism as in course 1, which suggests that tablet production and use were important. Students of course 2 then became more familiar with the building blocks of calculation on the one hand, and with producing and writing on large tablets on the other hand. The colophons suggest that tablet layout was important, as well as a rather erudite academic environment for course 2. This suggests education in course 2 was a preparation for, or was in itself, a kind of professional education. This is, however, mere conjecture based on the completeness of course 1 compared to course 2.[20] It is difficult to state more on this subject, such as to describe the communities these schools would have served, without information on the provenances of the texts.

For Ur, there is a clear distinction between elementary and advanced phases similar to that described by Proust (2007) for Nippur. The elementary phase, explicitly visible in only two type I tablets, although tacitly visible in the numerous type IV tablets, consisted of the memorization of metrological tables and, if it is similar to Nippur, lists as well. Numerical tables are implied by the content of the type IV tablets. An advanced phase is also visible from the type IV tablets, which is plausibly summed up by Friberg (2000: 146 citing Robson 1999)[21]:

> The remaining 21 texts edited by Robson were explained in §§ 2a-2j of this paper, where it was demonstrated that the calculations in these 21 texts can be clearly associated with 10 different topics of OB mathematics: a-b) omputing (sic) the square (of a square, or a cube) of a regular sexagesimal number, c) computing the reciprocal of a regular sexagesimal number, using a factorization method, d) computing the square root of a semiregular sexagesimal number, using a variant of the same factorization method, e) solving a quadratic-linear system of equations, using the rule of false value, f) computing the area of a quadrilateral, using the traditional, but incorrect quadrilateral area rule, g) solving some

[20]One could also suggest that these courses represent different phases in education, that is to say course 2, which concentrated on numerical tables, occurred after course 1 which presented both metrological and numerical tables, or that these represent formats demanded by two different instructors within the same school—both are plausible reasons for the distinctions in tablet shape and content. Unfortunately, for now, the evidence for these courses is too sparse and circumstantial to state anything with certainty.

[21]This is only a plausible and even probable reconstruction because, as stated above, the many type IV tablets published by Robson make no reference to a written problem, they only represent calculation in tabular format. Therefore, Friberg's reconstruction, which is quite plausible and followed here, cannot be confirmed.

problem about three shares of an inheritance, in an arithmetic progression, h) computing the volumes of excavated canals or substructures, calculating also the cost in silver for wages, or the daily progress, i) computing the capacity in cylinder-sìlas of a series of standard measuring vessels, j) computing the number of cylinder-sìlas contained in various structures, possibly large granaries.

Regional variation is suggested, though not confirmed, by the shape and layout of these mathematical texts. A brief exploration of tablet types and their layout suggests variation by city and the possibility of multiple schools within one city, the city of Larsa. The next sections explore the nature of elementary education, that is, the content of these tablets, in greater depth.

2.2.2 Metrological Lists and Tables in the Scribal Curriculum

According to Proust's study of Nippur, the scribal education as it pertains to mathematics took place in two distinct phases: an elementary phase and an advanced phase. As proposed above, tablet shape, structure and content suggest these same two phases in texts from Larsa and Ur as well. Consequently, the present and the following section explore the following questions: 'if tablets differed from place to place, how uniform was the content of the texts', 'what made up this curriculum' and 'how uniform was this curriculum throughout the kingdom of Larsa'?

Proust (2007: 97) points out that more than ninety per cent of mathematical tablets excavated at Nippur belonged to the elementary phase of education, attesting to its importance in the formation of the scribal art. Evidence for this phase consists of two main groups: metrological lists and tables, which will be discussed here, and numerical tables, discussed below. As shown above, this is largely borne out for the city of Larsa, but at Ur the majority of evidence is indirectly derived from type IV exercise tablets dealing with calculations of various sorts. However, two lists from Ur, both found on type I tablets, as well as the makeup of the calculation exercises found on type IV tablets, suggest a significant, though somewhat elusive elementary phase similar to that witnessed at Nippur and Larsa. What follows is a description of elementary education at Nippur, Larsa and Ur based on the available evidence.

Metrological lists made up the very beginnings of the elementary mathematical education, starting with capacity lists, followed by weight lists, area lists and length lists.[22] These lists, as their name implies, are lists of measurement values stating numerical values followed by the measurement units qualifying them, starting with

[22]For a concise synopsis of the order of the scribal curriculum, see Proust (2007: 151–152, Fig. 9 and Annexe 1, 255–262). Proust shows that the mathematical texts were learned in tandem with the lexical texts.

the smallest units and moving to the largest (Proust 2007: 98). At Nippur, lists present a total of around 620 entries with approximately 180 for capacity, 170 for weight, 110 for area and volume and 160 for length (*ibid.*: 99). The first set to be memorized, capacity, appears most often, comprising seventy-one per cent of all lists from Nippur (*ibid.*: 114). Lists were memorized, according to their appearances on type I and type II tablets, in a fixed order starting with capacity, then weight, area/volume and finally length (*ibid.*: 99).

It is possible that metrological tables present at Nippur appeared in the scribal education after the metrological list for capacity was learned. These tables also commence with capacities. Capacity tables, like lists, appear most frequently at Nippur, with sixty per cent of tables concerned with capacity (*ibid.*: 114). In addition to the four lists mentioned above, a table for height appears, with around eighty entries. Metrological tables were memorized in the same order as the lists described above, adding the table for height to the curriculum towards the end of the elementary phase of education (*ibid.*: 99). Tables are distinct from lists in that they list the same entries but provide a SPVN transformation for each entry (*ibid.*: 98). As Proust (2009: Sect. 4.1) states:

> The issue of the respective pedagogical function of metrological lists and tables has not been exhaustively described (…). Whatever their precise role in the curriculum may have been, metrological tables provided future scribes with two fundamental notions that are new in relation to the lists: the sexagesimal place value notation and a correspondence between the measures and these positional numbers.

Interestingly, the Nippur tables express similarities with other tables, such as those from the city of Larsa as exhibited by Table 2.9.

As seen in Table 2.9,[23] on the left of these metrological tablets is a measurement value consisting of a numerical value followed by a measurement unit, while on the right this measurement value is transformed into sexagesimal place value notation. These texts present the beginnings of the weight tables and, while the Nippur exemplar is broken at the beginning, show the same table when extant. Comparison of the Larsa text with metrological lists from Nippur, such as obverse column iv of HS 249, shows that the same entries probably existed at the beginning of the table of weights in both Larsa and Nippur (cf. Proust 2008: 23). At Larsa there are lists for capacity and tables for area, length and height as well.[24] The extant sections of these lists and tables show entries that are exactly the same or similar to those from Nippur when available.

An interesting facet of metrological tables is the relationships they provide between measurement values and SPVN. Whole measurement values, such as 1 *še*

[23]HS 235 appears in Hilprecht (1906: pl. 21 as no. 31). It is recopied in Proust (2008: pl. 18 as no. 25 and transliterated on p. 40). Note that Ashm 1923-410 first appears in copy and transliteration in Robson (2004a: 22–23). In Table 2.9, only the table is translated, although there is a colophon which provides the day on which the text was produced: ‘u$_4$ 2(u) 7(diš)-kam’, ‘day 27’.

[24]See Appendix 3 for the tablets from Nippur, Larsa and Ur catalogued by content, including by metrological system.

Table 2.9 Comparison of HS 235 (left), and Ashm 1923-410 (right)

			Obv.	
			1/2 *še* silver	10
			1 *še*	20
			1 1/2 *še*	30
			2 *še*	40
			2 1/2 *še*	50
			3 *še*	1
			4 *še*	1:20
			5 *še*	1:40
			6 *še*	2
			7 *še*	2:20
			8 *še*	2:40
			9 *še*	3
			10 *še*	3:20
			11 *še*	3.40
			12 *še*	[4]
			[13] *še*	4:[20]
			[14] *še*	4:[40]
Obv.			Rev.	
* Several lines broken *			[15 *še*	5]
16	*še*	5:[20]	[16 *še*	5:20]
17	*še*	5:40	17 *še*	[5:40]
18	*še*	6	18 *še*	6
19	*še*	6:20	19 *še*	6:20
20	*še*	6:40	20 *še*	6:40
21	*še*	7		
22	*še*	7:20		
22 1/2	*še*	7:30		
[2]3	*še*	7:40		
[2]4	*še*	8		
Rev.				
[25]	*še*	⸢8:20⸣		
[26]	*še*	8:40		
[27]	*še*	9		
[2]8	*še*	9:20		
[2]9	*še*	9:40		
[one-6$^{\text{th}}$ *gin*]	*še*	10		
[one-6$^{\text{th}}$ *gin*	]*še*	13:20		
[one-4$^{\text{th}}$ *gin*	*še*	1]5		
rest broken				

in the tables of weight presented above, did not always correspond to 1 in SPVN. Indeed, 1 *še* transformed into 20 in SPVN in the table of weights, while 1 in SPVN coincided with 3 *še* weight. This shows that transformation between measurement units and SPVN was not one to one. Table 2.10 presents this for the entire series as visible at Nippur and summarized by Proust (2007: 311–15).

In Table 2.10, the measurement system is stated in the headings of columns I through V. Each column is then divided into two parts reflecting metrological lists and tables. On the left is a list of measurement values as transliterated from each list. On the right is a list of SPVN numbers in translation that these values transformed into. Table 2.10 represents measurement value shifts in each measurement system, that is, when a shift occurs between an integer number and a fraction or from one measurement unit to another measurement unit for capacity, weight, area, length and height in the left-hand columns. At the same time the right-hand columns show each time that an SPVN cycle of 1 through 59 is repeated when transformed from a measurement value to its SPVN transformation.

Each list starts when a metrological table starts. For capacity, 1(diš) gin_2, which transforms to 1 in SPVN, shifts to 1/3 $sila_3$, which transforms to 20 in SPVN, and then to 1(diš) $sila_3$, the transformation of 1 in SPVN again. There are two shifts in this example: the measurement unit *gin* shifts to the measurement unit *sila* when the numerical value shifts from an integer number to a fraction, 1/3, and then shifts from fractions to integer numbers at 1 *sila*. 1 *gin* also begins one SPVN cycle of 1 through 59, which repeats at 1 *sila*, associated with SPVN 1. For capacity, there are eight total repetitions in SPVN cycles, while there are thirteen shifts in measurement value. For weight there are seven SPVN cycle repetitions, for area seven are suggested, four with length and three with height. At the same time, there are eleven measurement value shifts with weight, fourteen with area, seven with length and seven with height. Measurement value shifts do not match SPVN cycle repetitions for one simple reason: sexagesimal place value notation, as its name implies, is sexagesimal, while the measurement systems are typically not.[25]

The placement of shifts and repetitions provides a tool to evaluate the metrological tables and lists present throughout the kingdom of Larsa. While evidence is far from complete and often broken, when two measurement value shifts or SPVN cycle repetitions are present, it is safe to suggest that the students within this center were learning the measurement values and their SPVN transformations between these shifts or repetitions. This is not to say that the entire system was presented in the same manner with the same entry throughout southern Mesopotamia. This tool only provides a starting point for investigation from sparse evidence. It is proposed here, then, that if a shift or repetition is present, the students probably learned where this shift fitted into the metrological and numerical system. Moreover, if there is an additional shift in measurement value or SPVN cycle repetition in one center that is

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[25]Weight is an exception, although even this is not sexagesimal in the case of *še* measurement values.

I. Capacity		II. Weight		III. Area		IV. Length		V. Height	
1(diš) gin$_2$	1	1/2 še	10	1/3 sar	20	1(diš) šu-si	10	1(diš) šu-si	2
1/3 sila$_3$	20	1(diš) še	20	1(diš) sar	1	6(diš) šu-si	1	1/3 kuš$_3$	20
1(diš) sila$_3$	1	3(diš) še	1	1(ubu) GAN$_2$	50	1/3 kuš$_3$	1:40	1(diš) kuš$_3$	1
1(ban$_2$)	10	igi 6 gal$_2$ gin$_2$	10	1(ubu) GAN$_2$ 10 sar	1	1(diš) kuš$_3$	5	1/2 ninda	6
1(bariga)	1	1(diš) gin$_2$	1	1(aš) GAN$_2$	1:40	1/2 ninda	30	1(diš) ninda	12
1(aš) gur	5	1/3 ma-na	20	1(eše$_3$) GAN$_2$	10	1(diš) ninda	1	5(diš) ninda	1
1(u) 2(aš) gur	1	1 ma-na	1	1(bur$_3$) GAN$_2$	30	1(diš) UŠ	1	1(diš) UŠ	12
1(geš$_2$) gur	5	1(aš) gu$_2$ ku$_3$-babbar	1	2(bur$_3$) GAN$_2$	1	1/2 danna	15	5(diš) UŠ	1
1(geš'u)	50	1(geš$_2$) gu$_2$	1	1(bur'u) GAN$_2$	5	1(diš) danna	30	1/2 danna	3
1(geš'u) 2(geš$_2$) gur	1	1(geš'u) gu$_2$	10	1(šar$_2$) GAN$_2$	30	2(diš) danna	1	1(diš) danna	6
1(šar$_2$)	5	1(šar$_2$) gu$_2$	1	2(šar$_2$) GAN$_2$	1	5(u) danna	25		
1(šar'u)	50	1(šar'u) gu$_2$	10	1(šar'u) GAN$_2$	5				
1(šar'u) 2(šar$_2$) gur	1	1(šar$_2$) gal gu$_2$	1	1(šar$_2$) gal GAN$_2$	30				
1(šar$_2$) gal gur	5			1(šar$_2$) gal šu-nu-tag GAN$_2$	30				
1(šar$_2$) gal šu-nu-tag gur	5								

Table 2.10 Measurement values and cycle shifts from Nippur

not witnessed in another, then this is evidence for variation in how the numerical system was presented in a scribal center.

Five summary tables are presented below, based on metrological systems that appear in the Old Babylonian elementary education as constructed by Proust for Nippur. These tables sum up capacity, weight, area and volume, length and height following the summary in Table 2.10. Each table is subdivided into three main columns, a column showing where measurement value shifts and SPVN cycle repetitions occur in the lists and tables, first from Nippur, then Larsa and finally Ur.[26] Underlined values and numbers are reconstructed, so that when an SPVN transformation is underlined in the right column, this means that an entry is only present on a metrological list.

When an entry is not explicitly present on a list or table, or when an SPVN transformation is not present, this does not preclude its original presence in the curriculum. For instance, the later entries for the capacity tables at Nippur are missing SPVN transformations. However, HS 234, published in Proust (2008), was probably originally a complete metrological table of capacity, at the least presenting the values constructed on the composite list. Numerous lists, like HS 257 + 275 which is also published in Proust (2008), present much of what is missing but in list form, devoid of SPVN transformations, while tables from throughout Mesopotamia suggest what would have been on these lists. Moreover, breaks on HS 234 suggest that this text would have continued, as shown by Proust's reconstruction (2008: 37). Indeed, as Proust (2008: 34) states, texts on this tablet were probably even erased in antiquity for reuse. With this in mind, underlined values or numbers here are not directly found on any metrological list or table from the city mentioned in the head column, they are modern reconstructed values projecting which measurement value shifts and SPVN cycle repetitions were probably presented on metrological lists and tables based on evidence from elsewhere. Note also that, as described above, all metrological tables from the city of Larsa are hypothesized as deriving from course 1.

Table 2.11 shows a nearly complete metrological table of capacity for the city of Nippur, and suggests that missing SPVN numbers probably did exist at some point but are lost today. For the city of Larsa it is difficult to tell how far the table extended after *ban*, but it appears to begin at 1/3 *sila*, suggesting microcultural variations between Nippur and Larsa. There is no extant evidence for Ur.

Table 2.12 suggests a complete table of weight for Nippur, even if much of this table is missing extant entries. Indeed, the last list entry for Nippur, although lacking an SPVN transformation, shows that this value was learned in the elementary phase of education and thus that the prior shifts in measurement value were learned as well. Because there are SPVN transformations from one-6th *gin* through 1 *gu* silver, it is possible to suggest that SPVN transformations were present with the rest of the table. For Larsa the beginning of the table of weight possibly started at 1/2 *še*, just as it does for Nippur, although it is impossible to say how much more of this table was learned. No evidence is extant for Ur.

[26]These tables are summarized in the composite table produced in Proust (2007).

Table 2.11 Capacity compared between scribal centers

Capacity					
Nippur		Larsa		Ur	
1(diš) gin$_{2}$	1				
1/3 sila$_{3}$	20	1/3 sila$_{3}$	20		
1(diš) sila$_{3}$	1	1(diš) sila$_{3}$	1		
1(ban$_{2}$)	10	1(diš) (ban$_{2}$)	10		
1(bariga)	1				
1(aš) gur	5				
1(u) 2(aš) gur	1				
1(geš$_{2}$) gur	5				
1(geš'u)	50				
1(geš'u) 2(geš$_{2}$) gur	1				
1(šar$_{2}$)	5				
1(šar'u)	50				
1(šar'u) 2(šar$_{2}$) gur	1				
1(šar$_{2}$) gal gur	5				
1(šar$_{2}$) gal šu-nu-tag gur	5				

Table 2.12 Weight compared between scribal centers

Weight					
Nippur		Larsa		Ur	
1/2 še	10	1/2 še	10		
1(diš) še	20	1(diš) še	20		
3(diš) še	1	3(diš) še	1		
igi 6-gal$_{2}$ gin$_{2}$	10				
1(diš) gin$_{2}$	1				
1/3 ma-na	20				
1(diš) ma-na	1				
1(aš) gu$_{2}$ ku$_{3}$-babbar	1				
1(geš$_{2}$) gu$_{2}$	1				
1(geš'u) gu$_{2}$	10				
1(šar$_{2}$) gu$_{2}$	1				
1(šar'u) gu$_{2}$	10				
1(šargal)^{gal} gu$_{2}$	1				

Table 2.13 Area and volume compared between scribal centers

Area and volume					
Nippur		Larsa		Ur	
1/3 sar	20				
1(diš) sar	1				
1(ubu) GAN$_2$	50				
1(ubu) GAN$_2$ 10 sar	1				
1(aš) GAN$_2$	1:40				
1(eše$_3$) GAN$_2$	10				
1(bur$_3$) GAN$_2$	30				
2(bur$_3$) GAN$_2$	1				
1(bur'u) GAN$_2$	5				
1(šar$_2$) GAN$_2$	30	1(šar$_2$) GAN$_2$	30		
2(šar$_2$) GAN$_2$	1	2(šar$_2$) GAN$_2$	1		
1(šar'u) GAN$_2$	5				
1(šar$_2$) gal GAN$_2$	30				
1(šar$_2$) gal šu-nu-tag GAN$_2$	30				

Table 2.14 Length compared between scribal centers

Length					
Nippur		Larsa		Ur	
1(diš) šu-si	10	1(diš) šu-si	10	1(diš) šu-si	10
6(diš) šu-si	1	6(diš) šu-si	1	6(diš) šu-si	1
1/3 kuš$_3$	1.40	1/3 kuš$_3$	1.40	1/3 kuš$_3$	1.40
1(diš) kuš$_3$	5	1(diš) kuš$_3$	5	1(diš) kuš$_3$	5
1/2 ninda	30	1/2 ninda	30	1/2 ninda	30
1(diš) ninda	1	1(diš) ninda	1	1(diš) ninda	1
1(diš) UŠ	1	1(diš) UŠ	1	1(diš) UŠ	1
1/3 danna	10			1/3 danna	10
1/2 danna	15	1/2 danna	15	1/2 danna	15
1(diš) danna	30	1(diš) danna	30	1(diš) danna	30
2(diš) danna	1	2(diš) danna	1	2(diš) danna	1
5(u) danna	25	5(u) danna	25		
		[1(geš$_2^?$)] danna	30		

Table 2.15 Height compared between scribal centers

Height					
Nippur		Larsa		Ur	
1(diš) šu-si	2	1(diš) šu-si	2	1(diš) šu-si	2
1/3 kuš$_3$	20	1/3 kuš$_3$	20	1/3 kuš$_3$	20
1(diš) kuš$_3$	1	1(diš) kuš$_3$	1	1(diš) kuš$_3$	1
1/2 ninda	6	1/2 ninda	6	1/2 ninda	6
1(diš) ninda	12	1(diš) ninda	12	1(diš) ninda	12
5(diš) ninda	1	5(diš) ninda	1	5(diš) ninda	1
1(diš) UŠ	12	1(diš) UŠ	12	1(diš) UŠ	12
5(diš) UŠ	1			5(diš) UŠ	1
1/2 danna	3			1/2 danna	3
1(diš) danna	6			1(diš) danna	6
				1(u) 1(diš) danna	1:6
				2(u) danna	2

Similar to Tables 2.12 and 2.13 shows a nearly complete list for Nippur and probably a complete table as well, for similar reasons: the first and last entries are maintained in list form and SPVN transformations suggest that these probably extended throughout the system of area and volume for Nippur. For Larsa, evidence is again sparse but important. The existence of metrological tables of area and volume at 1 *šar* and 2 *šar* suggests that this list extended at least above and possibly below these values. Perhaps, just as capacity probably began at 1/3 *sila*, the table for area and height would have begun at 1/3 *sar*. This is mere conjecture at this point. There is no extant evidence for Ur.

Lengths as presented in Table 2.14 show nearly complete lists for each center. Ur lacks 50 *danna*. While the last repetition in the SPVN cycle occurs at 2 *danna*, extant entries stop at 20 *danna*, suggesting that a complete table once existed. Larsa seems to go beyond 50 *danna* to 1 × 60 *danna* and perhaps even 2 × 60 *danna*, although the table is broken off at the end. In addition, at Nippur 1/3 *danna* is present on a list while it is present on a table at Ur, but at Larsa, 1/3 *danna* is not present, suggesting a moderate shift in style between centers. Thus, there is some microcultural variation between centers as to where metrological tables start and end, as well as where shifts appear when evidence is more complete.

Table 2.15 shows significant microcultural variations between locations. All centers show evidence for 1 *šusi*, the beginning of the table for height. However, for Nippur evidence ends at 1/2 danna, although due to breaks this may have continued to 1 danna. At Larsa the last measurement value shift occurs at 1 UŠ, the last entry at 1 × 60 + 50 UŠ, so that the list for height may have stopped here. At Ur, however, evidence for a complete table exists with entries from 1 *šusi* to 20 *danna*. Indeed, 20 *danna* goes beyond the composite lists produced by Proust for Nippur.

Thus, as with the table for length it seems that when evidence is more complete for a system, there are evident variations in where lists and tables end.

The evidence brought to light here suggests that there is some variation between metrological tables at Nippur, Larsa and Ur. This leads to the conclusion that each center had its own microculture of mathematical activity, at least as far as metrology is concerned. For capacity, as present in Table 2.11, it seems that the table from Larsa started at 1/3 *sila* while it started at 1 *gin* in Nippur. For weight, both centers offer evidence that the table commenced at 1/2 *še*. For length and height, all three centers commenced at the same point, in each instance 1 *šusi* for both tables. However, length and height exhibited variation in the extant conclusions of the lists and even, in the case of length, their composition. 1/3 *danna* was present in list form at Nippur and on a metrological table from Ur, but absent from Larsa. Tables for area and volume were inconclusive, although it was hypothesized that at Larsa this list began at 1/3 *sar* if it was consistent with capacity, which would match where area and volume commenced at Nippur.

These conclusions are preliminary and rely on a very limited number of texts. The construction of a composite text at this point is only possible for Nippur, and Proust has already done this in her 2007 and 2008 books. This is not possible for Larsa and Ur. For instance, for Larsa it is only possible to suggest where the table for capacity starts—which probably differed from the starting point of the table for capacity at Nippur—but not how far it extends. Weight seems to have begun at 1/2 *še* silver at Larsa and Nippur, but again, at Larsa it cannot be stated how far this table extended. It is certain that a table for area and volume existed at Larsa, but not where it started and where it concluded. However, it is possible with relative certainty to produce length and height tables for each center. The variations exhibited between these length and height tables serve as a warning: without relatively complete data it is not possible to predict everything that would appear on a composite table, that is, where a table starts and ends, and the entries that existed on these tables. Thus, while such complete tables would be invaluable to this study, more evidence is needed to produce these tables for each scribal center except Nippur.

Capacity, weight, area and volume, length and height all correspond to the same SPVN numbers between centers. The system itself did not change. Whether a shift occurred at 1/3 *danna* rather than 1/2 *danna*, their SPVN transformations were the same. 15 is still the transformation of 1/2 *danna*. Further, if a scribe wrote a value of 1/3 *danna* or 10 UŠ, the SPVN transformation remained 10. Only the representation of measurement value changed between location. The metrological and numerical systems remained consistent between the centers.

On first glance, when the lists and tables are examined individually, it seems as if entries in each text differ between the centers. For instance, at Ur, as is witnessed by

UET 7, 114, length measurement values commence with 1 *šusi,* 1 1/2 *šusi*, 2 *šusi*, 2 1/2 *šusi* and 3 *šusi*, a deviation from Nippur where 1 *šusi,* 2 *šusi* and 3 *šusi* appear in HS 241. At Ur, inclusion of 1/2 *šusi* shows finer granularity[27]: 1/2 *šusi* is presented and provided with the SPVN number 5. The same phenomenon occurs with height. At Nippur, only 1 *šusi,* 2 *šusi* and 3 *šusi* appear (cf. for instance HS 243), while at Ur 1 1/2 *šusi* and 2 1/2 *šusi* are included on UET 7, 115. Inclusion of entries for 1/2 *šusi* at Ur also provides finer granularity. The use of 1/2 *šusi* at Ur is probably not a singular occurrence but one that is reflected in a basic list for both length and height. Several reasons support this conclusion. First, the table of lengths occurs on two separate tablets, UET 7, 114 and UET 7, 115, confirming that these are not singular occurrences. Second, the table of heights also appears on UET 7, 115 confirming that 1/2 *šusi* is common to both the table of length and the table of height. Finally, both UET 7, 114 and UET 7, 115 are type I tablets, which present summaries of the curriculum, not simple exercises. Thus, while both Nippur and Ur used the same metrological and numerical system, current evidence suggests that schools differed in how and what was learned concerning each of these systems. This is further suggested with the inclusion of 11 through 20 *danna* at Ur in UET 7, 115 and its apparent absence at Nippur.

Both Ashm 1922-366 and AO 08865, two prisms presumably from Larsa, state only 1 *šusi,* 2 *šusi* and 3 *šusi* as well as their SPVN transformations for length and, with Ashm 1922-366, height as well. This suggests that at Larsa the beginnings of the lists for length and height were the same as those learned at Nippur. Again, the existence of two exemplars suggests that this is the typical curriculum. That both exemplars are prisms suggests that they are summaries of the systems and not simple exercises. However, the lists from Ur and Larsa show increments of 5 *ninda* from 10 *ninda* up to 55 *ninda*, a deviation from Nippur where increments of 10 are seen from 10 *ninda* to 50 *ninda* on HS 249 + 1805, a type I tablet that lists length measurement values.

Thus, metrological lists and tables that are typical of each scribal center begin to emerge. These lists and tables seem to differ from location to location. This is not to say that the presentation of all curricula deviates significantly between centers. For instance, where extant, that is between 1/2 *še* and 20 *še*, the tables of weights do not deviate between Nippur and Larsa.[28] The same can be said for capacity. From 1/3 *sila* on, measurement values found at Larsa (Ashm 1932-526n) are exactly the same as measurement values found on the lists and tables from Nippur (see for instance NI 3759).

Deviation between lists can appear within one scribal center as well. This can be expected at Larsa because there were possibly two schools in this center. At Nippur,

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[27]Granularity is understood as the detail produced by a measurement value. A decrease in granularity is understood as a decrease in fineness and increase in coarseness of a measurement value. An increase in granularity denotes an increase in fineness and decrease in coarseness of a measurement value. Thus, for instance, *sila* is finer than *ban*, which is finer than *bariga*. This convention is followed throughout the present volume.

[28]Cf. for instance Ashm 1923-410 at Larsa and NI 3742 for Nippur.

HS 235, a type II tablet from Nippur transliterated above (Table 2.9), shows 22 *še*, 22 1/2 *še* and 23 *še*. This differs from a list on HS 242, a type III tablet, and in a table on NI 3515, a type III tablet, reverse column I, both from Nippur, where only 22 *še* and 23 *še* appear. However, on HS 235, only 22 *še* appears with 1/2, a deviation from the rest of the quantities described on HS 235 itself, so that this can be understood as an irregularity, perhaps an insertion made by a teacher to instruct the student on how the numerical and metrological system worked.

Veldhuis (1997: 148–149) speaks of the ancient teacher's own production which was passed on and memorized by the student:

> The ancient composition was not located in one exemplar to be used as a reference copy. It was rather found in the memories of those who learned it by heart: first the teacher and then his pupils. The teacher produced the model texts that the pupils had to copy from his memory. In their turn the pupils produced passages from their memories once they had learned them by heart. There was no one-to-one relation, however, between the text in the memory and the text as written.… The materialization of the composition when it is written down from memory is, therefore, not so much a process of copying something already present in memory, but rather the production of a text following the rules by which it is governed. These rules belong to what defines a genre.

Indeed, as Civil et al. (1979: 7) maintain, the teacher did not need to produce a document since he knew the material by heart. Only a student's work or, in the case of type II tablets, what a teacher wanted to present to students is represented in the texts. This distinction is important. A distinction was made above between the type II tablets on which scribes were introduced to and explored new materials, type III tablets on which scribes rehearsed and continued memorizing this material and type I tablets and prisms on which complete or almost complete compositions were written. Thus, HS 235, HS 242 and NI 3515 all present scribal exercises, while the type I tablets and prisms from Ur, Larsa and Nippur present the results of these exercises. The addition of 1/2 še on HS 235 is an example of a student learning the metrological system. As HS 242 and NI 3515 suggest, such insertions were not always part of typical exercises. Exercises can, then, deviate from a standard curriculum, as witnessed on type I tablets and prisms, based on the needs of the day, as the type II and III exercise tablets reflect. While the metrological system remained the same, presentation of this system differed between and within scribal centers, while content differed depending on the demands of teachers and the needs of students.

2.2.3 Numerical Tables and Elementary Education

If metrological lists and tables could vary between scribal centers and even within one center, what about numerical tables? Numerical tables were also memorized in the course of the elementary scribal education to facilitate calculation with sexagesimal place value notation. These tables included reciprocal tables, multiplication tables, tables of squares, tables of square roots and tables of cubed roots. Students began memorizing these tables shortly after they began memorizing metrological

tables in the city of Nippur, starting with reciprocal tables, moving to multiplication tables, then tables of squares, square roots and cube roots.[29] Again, this raises the questions: 'how uniform was the content of the numerical tables'? 'what did this part of the elementary scribal curriculum consist of'? and 'how uniform was it throughout the kingdom of Larsa'?

Neugebauer (1935–1937: I) already describes a common series of Old Babylonian tables similar to that produced for Nippur. This series of tables is described again in Neugebauer and Sachs (1945).[30] One very interesting aspect of the discussion in Neugebauer (1935–1937) that is not present in Neugebauer and Sachs (1945) is a listing of the available sources together with provenance when possible. This allowed for a breakdown of texts by location. Another Old Babylonian table revised by Friberg (2007: Appendix 2, 361–365) adds a multiplication table for 1:12, based on a type III tablet, MS 3866 (cf. *ibid.*: 74–76). An additional type I tablet published by Friberg, MS 3974, could add a multiplication table of 2:13:20 (*ibid.*: 85–87, 472–473).

Table 2.16 presents a comparison of the evidence for numerical tables from Nippur (N), Larsa (L) and Ur (U). 'Y' in a column states whether a table is present in one of these cities. Multiplication tables are listed by the SPVN number by which they multiply. Thus, SPVN 50 represents the multiplication table for 50.[31]

Several inferences can be drawn from Table 2.16. First, no table attested at Larsa or suggested for Ur is missing in Nippur. Second, while there is no complete set of tables outside of Nippur, all sources point to the same tables learned throughout the kingdom of Larsa. Thus, even when sources are lacking, similar texts were probably produced during a scribe's education at most of the scribal centers. There was a common core curriculum that presented numerical relationships in a similar manner. Third, these relationships were created by means of multiplication with SPVN. This becomes especially evident when the head numbers of the multiplication tables, that is, the numbers that commence a multiplication table, are compared with the reciprocal tables and with other aspects of the scribal curriculum.[32]

[29]See Proust (2007: 151–152, Fig. 9 and Annexe 1, 255–262) for this ordering. As noted above when describing tablet types, it is possible, as Proust showed, to reconstruct the order of the elementary mathematical scribal curriculum based on the appearance of extracts of this curriculum on the obverse and reverse of type II tablets. The extract on the obverse was a new extract that a student was memorizing from the instructor's own example, while the extract on the reverse had already been memorized by the student, so that by comparing all type II tablets, the order could be reconstructed. See the discussion of Type II tablets above for this.

[30]A standard reciprocal table is presented in Neugebauer (1935–1937: I 9–14) and Neugebauer and Sachs (1945: 11–12). Multiplication tables appear in Neugebauer (1935–1937: I 34–67, especially 34–35) and Neugebauer and Sachs (1945: 19–33). Squares and roots are discussed in Neugebauer (1935–1937: I 68–75) and Neugebauer and Sachs (1945: 33–35).

[31]This table is based on texts listed in Appendix 3. Note that at Ur, the existence of these tables can only be suggested based on the appearance of calculations in type IV practice tablets from this area. This is because no extant numerical tables exist for this city. Thus, for Ur, each suggested table is only hypothetical and its existence is uncertain.

[32]This is convincingly shown by Neugebauer (1935–37: 30ff).

Table 2.16 Numerical tables by provenance

N	L	U	Table
Y		Y	Reciprocals
Y		Y	50
Y		Y	45
Y		Y	44:26:40
Y	Y	Y	40
Y	Y		36
Y		Y	30
Y	Y	Y	25
Y	Y		24
Y	Y		22:30
Y	Y		20
Y			18
Y			16:40
Y			16
Y			15
Y			12:30
Y	Y		12
Y	Y	Y	10
Y			9
Y		Y	8:20
Y	Y		8
Y		Y	7:30
Y	Y		7:12
Y			7
Y			6:40
Y			6
Y		Y	5
Y		Y	4:30
Y	Y	Y	4
Y			3:45
Y			3:20
Y		Y	3
Y			2:30
Y			2:24
Y			2
Y		Y	1:40
Y		Y	1:30
Y			1:20
Y		Y	1:15
Y	Y		Squares
Y	Y		Square roots
Y	Y		Cube roots

Table 2.17 helps to illustrate an alignment of the reciprocal table (column I) with the head numbers of multiplication tables (column II) in translation as witnessed at Nippur and perhaps throughout the kingdom of Larsa. The bold print represents numbers that are either omitted from the reciprocal table or are omitted from the head numbers of multiplication tables, therefore, they appear in one or the other column only.

According to Proust (2007: 130–132), only fourteen multiplication tables are really needed to manipulate the numerical system: Tables 1 through 10, 20, 30, 40 and 50, while another six numbers were useful for operations of doubling. Thus, 22:30 is half of 45, 16:40 is 2:5 times 2^3, 12:30 is half of 25, 8:20 is 2:5 times 2^2, 7:12 is the reciprocal of 8:20 and 4:30 is half of 9. Friberg (2007: 87–97) points out that the head numbers of the multiplication tables are drawn from a variety of sources including the reciprocal tables (excluding three-place numbers, that is, numbers like 1:52:30 that have three place values), numbers useful for the education system (7 a non-regular number and 22:30 often used in the trailing parts algorithm),[33] translation factors (like 1:40 used to translate base sixty into centesimal quantities)[34] and coefficient lists (like 7:12, the *nalbanum* of type 1 bricks and its reciprocal 8:20).[35] Finally, all multipliers except the number 7 are regular numbers, linking these numbers with the reciprocal tables. This is all aptly summed up by Robson (2001a: 196) who states concerning multiplication tables—and this could equally apply to the reciprocal tables as well—'in sum, the set of multipliers appears to have been assembled because it gives good coverage of the numbers most likely to be used by scribes in their everyday arithmetical work'.

As Table 2.16 shows, there is some uniformity, or at least the potential for uniformity, throughout the kingdom of Larsa. While neither of the scribal centers outside of Nippur studied in this volume has a complete set of numerical tables, the traces of these curricula, when compared to the numerical tables of Nippur, show that the same set of tables was probably learned in each scribal center. However, there is some potential for variation even with the presentation of this numerical system. This is evident from comparing the tables of squares and square roots in Nippur and Larsa. Nippur shows the possibility of extending square roots beyond those witnessed at Larsa. Square root tables at Larsa end at '1(diš)-e 1(diš) ib_2-si_8,' 'to 1 the square root is 1' but continue at Nippur until 'to 1:2:3:4:3:2:1 the square root is 1:1:1:1'. Again, when extant, variation is evident in numerical tables just as it is in metrological tables. Core curriculum may have been similar, but there were some modest microcultural variations between scribal centers.

The numbers 1:12, the reciprocal of 50, and 2:13:20, the reciprocal of 27, deserve discussion at this point because they project additional variations within a curriculum that may have been related to numbers that scribes would use in everyday arithmetical

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[33]See Sect. 8.2.3 and Chap. 9 for training with non-regular numbers including the number 7, and then Chap. 9 and UET 6/2 295 in Appendix 1.B for the trailing parts algorithm.

[34]See PTS 247 in Appendix 1.B, which is possibly a practice text in translating centesimal numbers to sexagesimal numbers.

[35]Cf. Friberg (2007: 89) for examples of how this may have worked.

Table 2.17 Reciprocal tables and head number alignment (in translation)

I. Reciprocal		II. Multiplication table		
the reciprocal of 50 is	1:12	50	times 1	50
the reciprocal of 45 is	1:20	45	times 1	45
the reciprocal of 1:21 is	44:26:40	44:26:40	times 1	44:26:40
the reciprocal of 40 is	1:30	40	times 1	40
the reciprocal of 36 is	1:40	36	times 1	36
the reciprocal of 30 is	2	30	times 1	30
the reciprocal of 25 is	2:24	25	times 1	25
the reciprocal of 24 is	2:30	24	times 1	24
		22:30	**times 1**	**22:30**
the reciprocal of 20 is	3	20	times 1	20
the reciprocal of 18 is	3:20	18	times 1	18
		16:40	**times 1**	**16:40**
the reciprocal of 16 is	3:45	16	times 1	16
the reciprocal of 15 is	4	15	times 1	15
		12:30	**times 1**	**12:30**
the reciprocal of 12 is	5	12	times 1	12
the reciprocal of 10 is	6	10	times 1	10
the reciprocal of 9 is	6:40	9	times 1	9
		8:20	**times 1**	**8:20**
the reciprocal of 8 is	7:30	8	times 1	8
the reciprocal of 8 is	7:30	7:30	times 1	7:30
		7:12	**times 1**	**7:12**
		7	**times 1**	**7**
the reciprocal of 9 is	6:40	6:40	times 1	6:40
the reciprocal of 6 is	10	6	times 1	6
the reciprocal of 5 is	12	5	times 1	5
		4:30	**times 1**	**4:30**
the reciprocal of 4 is	15	4	times 1	4
the reciprocal of 16 is	3:45	3:45	times 1	3:45
the reciprocal of 18 is	3:20	3:20	times 1	3:20
the reciprocal of 3 is	20	3	times 1	3
the reciprocal of 24 is	2:30	2:30	times 1	2:30
the reciprocal of 25 is	2:24	2:24	times 1	2:24
the reciprocal of 27 is	**2:13:20**			
the reciprocal of 2 is	30	2	times 1	2
the reciprocal of 36 is	1:40	1:40	times 1	1:40
the reciprocal of 30 is	2	1:30	times 1	1:30
the reciprocal of 45 is	1:20	1:20	times 1	1:20
the reciprocal of 48 is	1:15	1:15	times 1	1:15
the reciprocal of 50 is	**1:12**			
the reciprocal of 32 is	**1:52:30**			
the reciprocal of 54 is	**1:6:40**			
the reciprocal of 1:4 is	**56:15**			

work. 1:12 is found on MS 3866, a type III tablet. As stated above, type III tablets are practice exercises in which a scribe is reviewing or memorizing a text he has already learned. Because it is an exercise, it is not certain that MS 3866 was actually part of the typical curriculum. Instead, it could well have been an addition to the curriculum, perhaps at the demand of the instructor, similar to the addition of 22 1/2 *še* to HS 235 discussed above. More likely, due to the nature of the tablet, this addition arose out of a student's desire to explore the numerical system more completely. The reason why this table would have been explored, as Friberg (*ibid.*: 93) suggests, may have been that 1:12 is the reciprocal of 50. In a mathematical culture where multiplication by a number's reciprocal is carried out in place of division, the ability to cope with and manipulate reciprocals is vital for performing basic mathematical activities. By memorizing both reciprocal tables and the multiplication tables that correspond to these reciprocals, a scribe is memorizing the building blocks to basic calculation in SPVN. The importance of reciprocals in basic computation explains why a student or teacher would request additional practice with reciprocals and the multiplication tables associated with these reciprocals. However, because MS 3866 is the only exemplar of this text, it is difficult to suggest it was part of a normal exercise in any school.

2:13:20, the reciprocal of 27, is found on MS 3974, a very worn type I tablet. 2:13:20 was probably an intentional part of the numerical system present in the educational environment that produced it because type I tablets reflect a complete or almost complete composition. However, like 1:12 found on MS 3866, this composition is not reflected in any other text and is unprovenanced. Thus, it is difficult to see the table of 2:13:20 as typical anywhere else but the environment it was written in. Perhaps this table reflects a specific need of a particular scribal environment, possibly a professional environment. As Friberg (2007: 89, 93–95) has pointed out, 2:13:20 is the carrying coefficient for a basket of earth. This setting would fit very well with the bureau of irrigation and excavation described below (Sect. 4.2) and may reflect knowledge passed down outside of the typical scribal curriculum. By memorizing a multiplication table associated with the carrying coefficient for a basket of earth, the aspiring scribe would be memorizing an additional building block important to his own professional computation using SPVN. This would mean that not all education occurred in a classroom setting but some knowledge may have been taught in a professional setting. However, 1:12 and 2:13:20 must be regarded as exceptions to a normal curriculum. They were not common throughout the kingdom of Larsa, but mark a specific exercise and the potential for additional exercises outside of a core curriculum present throughout the kingdom. Indeed, the table for 2:13:20 may be evidence for a microculture centered around a professional environment, and not a geographical location.

2.3 Conclusions

The numerical tables presented a series of building blocks which were memorized to facilitate calculation with SPVN. These building blocks consisted of three main parts: reciprocal tables, multiplication tables and tables of squares and roots. The scribe began

learning these, starting with the reciprocal tables, around the same time as he began memorizing metrological tables. Prior to this, metrological lists, which presented the measurement systems to students in each scribal center, were learned, starting with capacity. Metrological tables connected these systems to SPVN so that by memorizing the tables, scribes were easily able to transform measurement values into SPVN for calculation using the building blocks they learned with the numerical tables. Thus, the early scribal education presented an integrated system for expressing value and then manipulating this value through a multiplicative procedure.

The present study shows that multiple microcultures as defined in Chap. 1 probably existed throughout the kingdom of Larsa. These microcultures existed along regional lines, as evidenced by the existence of differences between metrological tables for length and height between Nippur, Ur and Larsa. In addition, there were differences along professional lines, as was suggested with the multiplication table for 2:13:20. The superficial differences in expressing the metrological and numerical systems show each of the different centers expounding on aspects of these tables in ways that are not present elsewhere, creating unique building blocks available to the scribes of each location. These building blocks helped to define the metrological and numerical system but cannot be understood as running contrary to the greater culture in which these lists were created. They merely allowed each scribe who engaged in these educational processes to develop a greater understanding and versatile approach to the system.

When variation occurred between these microcultures, whether it appeared in numerical exercises or metrological exercises, the essential systems remained the same. When 1:12 and 2:13:20 are present on numerical tables, this does not change the numerical system, nor would either value necessarily change the rest of the curriculum. They are only additions to the curriculum. With metrological texts, whether the presentation of a table of length ends at 50 *danna* or 1 $\times$ 60 *danna*, the system of length still has the same numerical basis. Whether a scribe wrote 1/3 *danna* or 10 UŠ, the SPVN transformation remained 10. Only the representation of measurement value changed.

No single center can be understood as typical. Content differed from place to place and within a place. However, these differing contents were based on a curriculum that represents the same basic system, and each text was the product of an aspiring scribe's interaction with this curriculum. While the data at hand may be limited, what it suggests is an image of a singular numerical and metrological system in existence throughout southern Mesopotamia that was expressed and taught differently between and within each scribal center, based on the demands of the teacher or the needs of a student. The metrological lists presented a uniform metrological system that was connected to SPVN via metrological tables. Numerical tables presented building blocks for calculation with SPVN. These building blocks were defined both by geography and by profession. However, it is not clear from this discussion whether calculation with SPVN is visible in the economic texts or not. Before this can be explored, it will help, first, to identify the accounting systems that the administrative texts formed, and then the environments in which these texts were produced.

Chapter 3
Text Types and Archival Practices in the Kingdom of Larsa

Abstract This project is in essence a study of numbers found in economic texts from Larsa, so it is important to examine the texts themselves and the mechanisms that define them. This chapter describes the texts, making an initial distinction between tabular and prosaic documents. Further distinction occurs between single transactions, lists and balanced accounts, as well as archival differences between personal archives, bureau archives and merchant archives. These texts are each parts of record-keeping apparatuses, so that single transactions would have been compiled into lists which would in turn be compiled into balanced accounts. Also, an individual may have acted in multiple capacities: one record might reflect practices employed to manage his own estate, another might conform to record-keeping practices within a bureau, while a further text would conform to practices common among merchants who procured silver on behalf of a palace or a temple authority. This chapter is supplemented by Appendix 1 where the economic texts themselves are presented.

The present project is a kind of textual study, one that examines mathematical practice in economic texts by means of discrepancies.[1] In pursuit of this study, this chapter examines the nature of written documents and their place in administrative record-keeping systems as a means to understand the archival structures to which the texts discussed here belong. Two main questions are asked: 'how can the texts be defined' and 'how are they related to each other'?

Two important arguments made by Assyriologists about the nature of record keeping in general will help to guide discussion. Foster (1982a: 22) states that 'administrative records derive from two principles: accountability, that is, the obligation to keep records for property that is not one's own, and responsibility, that

[1]Stol (1994), in his article concerning LB 1097, deserves credit as the first Assyriologist I am aware of who recognizes the importance of a mathematical interpretation to examine economic texts. See Appendix 1 here for LB 1097. The difference between Stol's interpretation and that espoused here is simple time: Since his 1994 publication, much has come to light about mathematical practice as related to education and the economic texts thanks to works like Robson (1999), Friberg (2000) and Proust (2007).

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is, formal physical custody of property that is not one's own'. Accountability and responsibility are important factors in economic or administrative records. To Steinkeller (2004: 80), the purpose of an accounting system is to prepare for the future, that is, planning. The purpose of written documents is to state already obtained numerical administrative data in order to present it to a higher authority which will then use this data to administer and expand a complex economy (*ibid.*: 79). According to these arguments, administrative data is gathered and processed for two purposes. On the one hand, it is gathered as a form of oversight to be used internally in order to keep track of outgoing and incoming goods and to state where responsibility for particular goods resides. This type of accounting is only relevant and recognizable within the archive where it is produced. On the other hand, administrative data can be gathered and processed to report to a higher authority. A text is the product of one particular archive to be used for planning purposes. However, as Steinkeller (*ibid.*: 73) further notes concerning the text (described as a 'document') 'usually, if not as a matter of course, the document offers an administrative version of the events, not an objective description of what actually happened'.

As an administrative version of events, texts can be predictive as well, while the production of a text implies only its potential future use. We turn to NBC 11509 to illustrate these points. NBC 11509, which is tentatively dated to around the thirty-first year of *Rīm-Sîn*'s reign, appears to estimate the volume of earth to be excavated in six different locations. It is thus a predictive text that could be used to plan a complex activity. It makes use of numerical data produced by an administrator to predict how much volume would be removed. Indeed, as stated in Appendix 2.L, the author of this text is probably a fairly high-ranking official in this bureau, an inspector who reported to the bureau head and oversaw canal contractors, who were themselves responsible for the day-to-day operations of canal excavations and maintenance.

NBC 11509, a predictive text, is probably part of a record-keeping system exhibiting the functions expressed by Foster, and later Steinkeller. Data would have been produced by an administrator, who processed this data and wrote it on NBC 11509. NBC 11509 would have been a tool created to aid in planning a project and could have informed a higher administrator of this planned project. In Sect. 4.2 below, it is proposed that NBC 11509 belongs to a bureau of irrigation and excavation similar to that presented by Walters in his 1970 monograph. As Walters shows in his work, the officials active in this bureau were also maintaining their own households so that texts belonging to a bureau may have been produced in a household environment. This is the case with NBC 05474, NBC 09050 and NBC 06339, which all belong to the same bureau discussed by Walters and are part of the *Lu-igisa* archive. They were produced by an actor, *Lu-igisa*, who was compiling a report of completed activity, data which could be used to assess and perhaps plan future endeavors, but he was working in a household setting even if he represented a bureau.

The *Lu-igisa* archive presents completed activities, but this is not what is seen in NBC 11509. The continued existence of NBC 11509 suggests that texts could also be created for potential use by administrators. Because it lacks a firm year date and because there are no similar texts expressing a completed transaction, it cannot be said with any certainty that NBC 11509 was used or had become redundant, only that it could be used for planning purposes and would become redundant. Provenance might shed light on this text's use: was it debris, tossed out or used as fill to line walls after its utility expired?[2] Or was it still housed in an archive waiting to be used? Unfortunately, like so many other Larsa texts, NBC 11509 lacks firm provenance.[3] This is a caveat that should be born in mind when discussing the predictive quality of a text: it may not have been utilized as intended or to its full potential.

Whether the texts were used as intended or not, they offer evidence for a lower household administration or an official reporting to or under the authority of a higher bureau administration or official. They also offer evidence that the higher bureau administration or official used data produced by these lower administrations or officials to predict and plan. The results of this planning would be passed down to a lower administration or official and at the same time, perhaps, reported to or under the authority of a still higher administration or official. This chapter will focus on text type and use, that is, how data are organized in texts, in order to answer the questions posed above, 'how can the texts be defined' and 'how are they related to each other'? Its purpose is to present the basic mechanics used by the texts to relate to each other in order to lay the groundwork for both the archival study presented in Chap. 4 (and Appendix 2) and the technical study on mathematics that make up this volume.

[2]The use of tablets as fill, and the appearance of tablets as debris after their utility had expired, have a long tradition in ancient southern Mesopotamia. Discussing texts from the Uruk period of the fourth millennium, Englund (1998: 41) states 'archival information which might have been derived from the excavated Uruk texts was in great part lost, due both to the recording method of the excavators, but also and fundamentally to the fact that the archaic texts from Uruk formed—seemingly without exception—part of the general debris of pottery shards, animal remains, etc., removed from administrative units of the central district Eanna and either deposited in trash holes or used as fill in constructions of walls and floors'. In so far as the Old Babylonian period is concerned, Charpin (1986: 481–82) noted that the so-called school texts found at No. 1, Broad Street were, in fact, fill used to construct walls. Finally, as noted in Chap. 1, only some of the texts from the city of Larsa itself that escaped pillaging were found in their original archival context. Of the remaining, some were picked up on the surface of the site or found in fill (Arnaud 1978: 165).

[3]Yet even with this information, it would be difficult to prove whether NBC 11509 had actually been used, or if its utility had simply expired at the end of the year so that a new text was written. This can only be shown by the discovery of a second text that refers to the same excavation with either similar data and a different month and date (suggesting a new survey), or one dated to year, month and day and which the data shows to have been a completed project.

3.1 Text Layout and Structure

Layout played an important role in the transparency and utility of each text. A distinction must be made between text and tablet. A text is understood as a written body of data while a tablet is understood as a document on which a text or part of a text is written. Focus here is on the text, not the tablet, although tablet shape can be important to a textual study.

3.1.1 Tabular and Prosaic Layout

Economic texts are laid out in one of two manners: prosaic or tabular formats.[4] The more common form is a prose-like, or 'prosaic' form as described by Robson (2004a: 116). Prosaic format describes a text that arranges data in a prose-like list so that one entry or set of entries leads to the next entry or set of entries. These texts can be lists like NBC 06339, which belongs to the *Lu-igisa* archive just mentioned and dated to *Sūmû-el* year sixteen.

NBC 06339 is effectively organized into two lists (lines 1 through 16). First, brick expenditures are listed at the beginning of each entry. Following this, a quantity of men is listed. At the end of each entry is the name of a person, presumably a foreman, which qualifies both the amount of bricks and men. In this text, the series of expenditures results in two totals, bricks in line 17 and men in line 18, which is followed by the statement of purpose and the date.

Prosaic texts can also be much more complex. An example is YBC 05586, dated to *Warad-Sîn* year 4a and attributed to the archive of an administrator named *Gimillum* in his capacity as bureau head of the grain storage bureau (see Sect. 4.1 and Appendix 2.G). In YBC 05586, a text about grain delivery and storage, data is presented as a series of lists. The lists appear one after another, starting with a series of capital deliveries followed by the delivery's guarantor(s) (giri$_3$), leading to a total which is qualified by the statement 'capital, out of which', then the delivery made, recipient, shipping costs and other details. When necessary, a statement of difference is provided for each section. YBC 05586 presents each delivery as an individual account, which will be described below as a balanced account, and at the end these lists are compiled into an itemized statement of capital shipped, deliveries made, costs and differences.

Robson (2004a: 116) defines a 'tabular' format 'as having both vertical and horizontal rulings to separate categories of information' while according to her, 'informal tables' only use spatial arrangement to organize and separate data. In Robson's study, tables may be headed or without headings, that is, they may or may not describe columns by a simple statement above each column. However, all the

[4]This distinction is made and discussed in Robson (2004a). For prosaic economic texts examined here, see Appendix 1.A.a. For tabular economic texts, see Appendix 1.A.b.

Table 3.1 Formal tables

I. Text	II. Subject	III. Archive or bureau	IV. Scribe	V. Year	VI. Location
YBC 04721	Grain disbursements	Bureau of irrigation and excavation	*Šamaš-aššu-aplu*	*Rīm-Sîn* year 01	Perhaps Larsa
NBC 11509	Excavations	Bureau of irrigation and excavation	Scribe I	*Rīm-Sîn* year 31?	Perhaps Larsa
Riftin 1937: no. 114	Labor and wages	Bureau of irrigation and excavation	scribe I	*Rīm-Sîn* year 31	Perhaps Larsa
MAH 15886 + 16295	Labor and wages	Bureau of irrigation and excavation	Scribe I	*Rīm-Sîn* year 31	Perhaps Larsa
Riftin 1937: no. 116	Labor and wages	Bureau of irrigation and excavation	Scribe I	*Rīm-Sîn* year 31	Perhaps Larsa
NBC 06763	Excavations	Bureau of irrigation and excavation	*Immer-ilī*	*Rīm-Sîn* year 38	Perhaps Larsa
Ashm 1923-340	Grain production	Grain production archive	Scribe P	*Hammu-rābi* year 35	Ur or Larsa
YBC 12273	Excavations	Bureau of irrigation and excavation	Scribe Q	*Hammu-rābi* year 38	Perhaps Larsa
Ashm 1922-290	Excavations	Bureau of irrigation and excavation	scribe R	Uncertain	Perhaps Larsa

tables in the present study are headed. According to Robson, there are two varieties of tabular texts: ‘formal tables’, in which data is arranged and calculated on two or more axes, and ‘tabular lists’ in which data is arranged along only one axis.

Nine formal tables and four tabular lists are discussed in the present volume, summarized in Tables 2.1 and 2.2 respectively. Organization in these tables is by year date and then by scribe (Tables 3.1 and 3.2).

Here, YBC 04721 and Ashm 1922-281 will be examined. YBC 04721, like YBC 05586 discussed above, can also be described as a balanced account, in which capital and expenditures are stated. Capital is stated in the first column, a list in its own right, with a total at the bottom of this list in lines 10–12. Expenditures are stated in the second, third and fourth columns, and all allocations to cities are stated in the headings. The sixth column, headed ‘mu-bi-im’, lists personal names. Column 5 lists totals of allocations by rows. The quantities in this column match column 1’s capital,[5] while lines 10–12 list totals by columns. Line 10–12 of column 5 states the total expenditures. Thus, in a similar manner as on YBC 05586, allocations are itemized by personal name in column 5 and by city in lines 10 through

[5]Robson (2004: 128) sees the totals in column 5 as a verification of the quantity in column 1. However, as is typical with balanced accounts (see below), this would not be a verification but a comparison of capital and expenditures.

Table 3.2 Tabular lists

I. Text	II. Subject	III. Archive or bureau	IV. Scribe	V. Year	VI. Location
Ashm 1922-281	Labor and wages	Bureau of irrigation and excavation	*Nabi-Šamaš* A	*Rīm-Sîn* year 01	Perhaps Larsa
Riftin 1937: no. 115	Labor	Bureau of irrigation and excavation	Scribe I	*Rīm-Sîn* year 31	Perhaps Larsa
LB 1075	Bappiru and salt disbursements	Uncertain bureau	*Sîn-iddinam*?	*Rīm-Sîn* year 39	Perhaps Larsa or north
Ashm 1922-277	Grain production	Grain production archive	Scribe P	*Hammu-rābi* year 35	Ur or Larsa

12, while a comparison of capital and expenditures appears in lines 10–12, column 1 and column 5. Both YBC 05586 and YBC 04721 present summaries of several balanced accounts, although in YBC 04721 data is presented in a more concise and efficient manner.

Ashm 1922-281 is much simpler and is more akin to NBC 06339. It is really two lists, a list of men in column 1 followed by a list of grain allocations, presumably for these men, in column 2, and a list of persons' names in column 3. These men are presumably the foremen or overseers of the men listed in column 1 as well as the recipients of grain stated in column 2. Totals per column are stated in lines 32 through 33. The chief difference between Ashm 1922-281 and NBC 06339 is in the use of space. In the text on NBC 06339, it is difficult to see at first glance which quantities are bricks and which quantities are men. In Ashm 1922-281, men and grain are clearly separated by a ruling.

The difference between tables and tabular lists is one of axis of organization. YBC 04721 has two clear axes of organization while Ashm 1922-281 has only one. However, both tabular lists and formal tables allow presentation of data in a more transparent manner than prosaic texts.

Methodological note: This discussion presents tabular and prosaic layouts of texts, a product of the ancient scribes, and not to be mistaken for modern tables produced by the author. The present work attempts to distinguish between tabular layouts, prosaic layouts which can be multi-columned and modern tables. Thus, when referring to the tabular layout of an ancient text, columns are designated by cardinal numbers as follows: column 1, column 2, column 3, etc. Multi-columned prosaic layout distinguishes columns by lower case Roman numerals: column i, column ii, column iii, etc. Finally, columns in modern tables are qualified by capitalized Roman numerals: column I, column II, column III, etc.

Table 3.3 Single transactions

I. Text	II. Subject	III. Archive or bureau	IV. Scribe	V. Year	VI. Location
NBC 08014	Sales contract of gold assessed in silver	Merchant	*Ilšu-ibbišu*	*Sîn-Iddinam* year 06	Perhaps Larsa
Ashm 1922-336	Grain expenditure	Merchant	*Šulpae-nāṣir* and *Ilī-ippalsa*	*Rīm-Sîn* year 01	Uncertain
A.26371	Loan/disbursement of grain	Merchant intermediaries	*Šēp-Sîn* B	*Hammu-rābi* year 40	Larsa
YBC 07787	Fish/date equivalency	Merchant intermediaries	*Iddin-Ištar*	*Hammu-rābi* year 43	Larsa
AUAM 73.2672	Date revenue	Merchant intermediaries	*Aḫiya*	*Samsu-Iluna* year 07	Larsa

3.1.2 Single Transactions

A first level of administration for a complex economy is found in small records and contracts that each describe a single transaction. They can plausibly be linked to a higher authority so that each text is an active component used to aid in planning or assessing activity. The texts suggest the existence of craft industries, the procurement of crafts by means of silver and grain,[6] as well as how this silver and grain was accumulated late in the period by means of merchant intermediaries.

Table 3.3 offers a summary of single transaction texts. In NBC 08014, silver in line 1, the equivalent value of gold stated in line 2 as assessed by the rate in line 3, is received by *Ilšu-ibbišu* in line 4. Six individuals as well as the *šatammu* officials were responsible for this silver delivery, each probably representing the institution providing the silver. In Ashm 1922-336, 3 *ban* grain in line 1, the equivalent value of silver for a sculptor is first checked and then stated as the property of two individuals. The existence of these texts shows that in both cases, a craft workshop was not employed full time.[7] Thus, NBC 08014 and Ashm 1922-336 both offer some evidence for the use of silver and grain as a medium for the evaluation and

[6]The word 'grain' is used here as a general term to describe any cultivated cereal, although in Mesopotamia the Sumerian word 'še' as an object (and as opposed to, for instance, a metrological element, for which see Chap. 2) typically denotes barley (*Hordeum vulgare*). See Charles (1984) for a distinction of Mesopotamian cereal crops, and Powell (1984) for a discussion of Sumerian evidence for cereal crops.

[7]This is a deviation from the economy described by Van de Mieroop (1987) on the Isin craft archives.

procurement of goods previously supplied by craft workshops.[8] They are probably part of an administrative system which uses silver and grain as a medium to procure and assess goods and services rather than produce these goods itself.

A system to accumulate silver and grain is evident below with silver and grain balanced accounts, as well as with A.26371, YBC 07787 and AUAM 73.2672. These texts all belong to a system in which the palace assessed the value in silver of property in the form of fish, dates, garlic and wool by means of merchant intermediaries during the reigns of *Hammu-rābi* and *Samsu-iluna* (Stol 1982: 130). As Stol (1982: 141) notes, the palace was concerned with only two commodities, barley or grain as seen in A.26371 and silver. This is seen in AUAM 73.2672 where dates are assessed by silver. YBC 07787 appears as a sale of fish and dates at one-third of their value and describes an amount to be 'weighed out' as the *sūtu*.

The nature of the *sūtu* has been a contentious point in the past: was the *sūtu* an obligation or an allocation? Koschaker (1942) believed this system of silver procurement or assessment was based on taxes. Thus, to him, the *sūtu* was a tax or was derived from a tax. Stol (1982) understood this as an allocation, that is, the palace entrusted surplus goods to the local merchant community, the *kārum*, which assessed the value of these goods in silver and returned one-third of the value in silver to the palace. This ensured a supply of silver to the palace with all risks taken by the merchant community. Charpin (1982) adds that this allocation was made to each merchant member of the *kārum*. Breckwoldt (1994) suggests that the *sūtu* holder only received one-third of the value in silver and repaid two-thirds of the value to the palace in two payments, one upon purchase and one upon demand. Földi (2014: 109) translates this term as 'concession' and points out that it refers to 'the right of collecting the commodities purchased by individual entrepreneurs from the State'. Finally, Van de Mieroop (1992: 241–50) points to the historic significance of such a system by pointing to a shift to a silver economy during the reigns of *Warad-Sîn* and *Rīm-Sîn*, as well as the movement of managing temple estates from the city of Ur to Larsa during the reign of *Rīm-Sîn* and ultimately to Babylon with *Hammu-rābi*'s conquest. The *sūtu* texts described here are evidence of this shift to a silver economy during *Hammu-rābi*'s administration. Evidence for this change under *Rīm-Sîn* is seen below, particularly in relation to the silver lists (Sect. 3.1.3) and silver balanced accounts (Sect. 3.1.4). Archives that make up this system are qualified here by the phrase 'merchant intermediaries'.

The five texts mentioned, NBC 08014 and Ashm 1922-336 as well as A.26371, AUAM 73.2672 and YBC 07787, record assessments of value, that is, they state potential values which are not necessarily representative of correct values. They are recordings made by officials who assess numerical data in order to estimate potential future activity, that is, expenditures or collections of silver or barley. In the case of NBC 08014, numerical data is for silver while estimated data is for gold. The silver value is expended by means of intermediaries so that in the text, gold

[8]This suggests that a similar process had occurred at Larsa as described by Van de Mieroop (1992: 243–245) for the city of Ur—that the economy shifted to a silver economy.

delivery is uncertain. For Ashm 1922-336 numerical data is a quantity of grain, estimated data is for silver and the uncertainty of this transaction is implied by the need for a third party to check it. For A.26371 the numerical data is flour, estimated data is the quantity of grain to be added to this flour and uncertainty is seen in the need for witnesses. This is similar to YBC 07787; while numerical data is more generally stated, it concerns edible fish and dates and a quantity of silver already paid out. Estimated data is the total value in silver for this fish and the values which are to be paid. Uncertainty in future payment is implied by reference to witnesses as well. Finally, with AUAM 73.2672, numerical data is a quantity of dates, estimated data is a quantity of silver and uncertainty is implied by the need for guarantors.

All five texts, then, represent collections of numerical data, whether collected by the scribe or authority who produced the text or another party, which is assessed for planning purposes by the scribe or authority responsible for the text, and which imply a future transaction, the completion of a delivery, completion of a sale or completion of an interest-bearing period. They are also predictive and allude to a higher authority potentially assessing these transactions, or a possible later assessment by the very same individual. However, it cannot be inferred from these texts alone that the transactions were completed, nor whether assessment was made. Finally, each text also implies a mathematical process, estimation, which will be further discussed in Chap. 8.

3.1.3 Lists

Lists appear in many forms and are the most common type of text presented here. The simplest kind of list presented here states only quantities and totals, and occasionally a day and month as well. These can be understood as personal accounts.

LB 1092 lacks a date but lists a series of expenditures in silver, often for grain, although parts of the text are broken. No total in weight is present, even though this total was clearly calculated and transformed into SPVN. LB 1091 is really two lists, a list of grain for baking followed by a subtotal, then a list of grain by persons' names followed by a subtotal and then a total, and then a dating to month four, day twenty-six. Finally, Ashm 1924-453 is really two lists. It describes grain disbursements over two days. Totals are not stated, although as in LB 1092, the SPVN transformations of the totals are stated.

LB 1092, LB 1091 and Ashm 1924-453 are each understood here as household records which state costs accrued in administering each household. Their lack of complete date formulas suggests they were probably temporary records. Indeed, these texts may be remnants of a record-keeping system like that described by William Hallo (2004) for a number of Ur III period texts from ancient Puzriš-Dagan, the modern site Drehem. Hallo (2004: 93) describes a system similar to modern double entry bookkeeping, in which two documents were produced for an

outgoing product: a debit (mu-ku_x(DU), 'delivery,' see below, this section)[9] and a credit (zi-ga or ba-zi, 'disbursement,' see below, this section). While outgoing deliveries were typically expressed on tablets at Drehem, they could also be written on bullae (*ibid.*: 94). Texts also appeared which mark the perspective of the person who was charged with disbursement before arrival at the final destination (i_3-dab, 'charge of'). However, because these texts are much terser compared with those recording credits, it is difficult to state that they were written on the same day, which complicates their connection with specific deliveries (*ibid.*: 94–95). Moreover, while originally multiple deliveries to a final destination would be listed together on debit and credit texts for one day, there was a shift so that single entries were listed on texts (*ibid.*: 96). 'All these examples could be multiplied ad libitum, but the point is clear: under a looser definition, these accounts qualify as examples of double entry bookkeeping in the sense that for each debit recorded in one text, there is a corresponding credit entered at the same time in another text' (*ibid.*: 96). These texts were then compiled into balanced accounts discussed below (Sect. 3.1.4) which state the transaction for the day, week or month (*ibid.*: 96–99).[10] Such a system would work well to maintain accountability within a single household or bureau archive.

It is quite possible that LB 1092, LB 1091 and Ashm 1924-453 reflect daily or even weekly accounts (LB 1092) and would be used to tabulate monthly (Ashm 1924-453) or yearly accounts (LB 1091), at which point they would become redundant and were discarded. The use of SPVN in both LB 1092 and Ashm 1924-453 underlines this point and suggests that the totals would be used in a further calculation. It follows that each of these texts are probably predictive as well. They would sum up numerical data in the form of a series of individual statements of household or merchant activity. Lack of a date and, as will be suggested in Chap. 5 and also in Chap. 6, the use of SPVN or partial SPVN shows that these texts refer to a future text. Whether they refer to different administrators or not, these texts refer both to a lower, that is earlier, administrative activity in which a transaction is first carried out, and a higher or later administrative activity in which the data found on each text is to be incorporated. In short, they sum up numerical data to be presented to a higher authority or revisited at a later date. However, lack of a date or a statement of an official compiling these texts suggests that all the activities are recorded within the same household or merchant environment so that, whether one or more scribes or administrators were present, a statement of authority and a date were not necessary.

The administrative system described by Hallo is not to be universally applied to the texts, as can be seen for NBC 05474, NBC 09050 and NBC 06339. These three texts, which are all part of the *Lu-igisa* archive mentioned above (see also Appendix 2.B), are also lists. However, unlike those simple lists mentioned above, these three

[9]For the reading of [DU] as ku_x, see Krecher (1987) and Bauer (2004).

[10]Note that this synopsis is not fully accepted in Assyriological circles. For another hypothesis of textual relationships, see the discussion of Steinkeller (2003) below.

texts present year date formulas. These are *Sūmû-el* of Larsa years fourteen (NBC 05474) and sixteen (NBC 09050 and NBC 06339). Each text presents quantities of bricks. Like LB 1092, LB 1091 and Ashm 1924-453, these are understood here as assessments of costs per day. However, because they have a year date, the lists of these costs were not expected to become redundant within the year they were produced but were probably permanent records created to assess activity for use outside of the household in which they were produced.

The *Lu-igisa* archive can perhaps be explained by a record-keeping system described by Steinkeller (2003: 44), this time within the Ur III province of Umma. The hypothetical relationship between texts, according to Steinkeller, works as follows:

> The records of deliveries (mu-DU tablets) and expenditures (sealed receipt tablets) produced in a given office were subsequently used by the office in question (or, probably more commonly, by the fiscal office) to compile, for each disbursing official, a separate balanced account (nig-SID-ak). After this was accomplished, receipt tablets would then be lent to other offices to verify their own records. Eventually, at the end of the year, all the records of a given office would apparently be transferred to the fiscal office. The latter would then digest the necessary information to calculate the total yearly contribution of each office, in terms of its commodity production and labour output.

To Steinkeller (*ibid.*), this administrative system would be carried out both to evaluate the different workshops and bureaus within Umma, and to assess the tax liability of the province of Umma owed to the centralized government in Ur. The merit of this system was to maintain accountability within and between several household or bureau archives.

If *Lu-igisa* was an administrator in an irrigation bureau (see Sect. 4.2 for this bureau), he would have needed to report or answer to other administrators within the bureau as well as assess the performance of his own subordinates. In this instance, *Lu-Igisa*, working within a bureaucracy, reported to a higher authority, not a fiscal office as is the case in Ur III Umma, but to a central administration within the irrigation bureau. The information he provided on tablets like the three mentioned above would have been digested by this central administration in order to assess productivity and output. The goal in this bureau, however, was not to assess taxes but to assess the state of irrigation projects being carried out by the bureau, what was done and what still needed to be done.

This shows that a full date, as well as the description of the project worked on, were necessary to assess and report activity. This would tally with Steinkeller's statement (2004: 79) that the purpose of an archive was to report to a higher authority. While these texts are part of a personal household archive, the appearance of a date points to their use in a broader administration as well, in contrast to LB 1092, LB 1091 and Ashm 1924-453, where the environment in which each text is produced implies an administrative authority. Again, the numerical data provided in these texts suggest interaction with lower administrators under *Lu-igisa*'s control, as well as interaction with a higher authority who uses these texts for planning

purposes with the totals and dates found on the texts. They sum up activity for an authority outside of the household environment managed by *Lu-igisa*, but within a larger bureau of which *Lu-igisa* is only a part.

Both lists and single transactions come together in a grain harvest archive witnessed by LB 1074, LB 1078 and LB 1069 (see Sect. 4.3 for this archive). While both LB 1078 and LB 1069 are only dated to month and day, not to a year, they probably date to *Rīm-Sîn*'s 38th year in power. Both texts state expenditures in grain for use in grain production. These texts, which describe agricultural activity for the field of *Hazazanum*, probably state a single agricultural project and would have been used to compile a fully dated assessment of costs similar to LB 1074. LB 1074 mentions fields described as fields of *Agakkum*, not *Hazazanum*.

Texts like LB 1074, LB 1078 and LB 1069 would have become redundant in the same way that the daily accounts mentioned above would become redundant. LB 1074 summarize completed activity while LB 1078 and LB 1069 either predict activity or summarize ongoing activity. It is therefore suggested here that undated texts could be used to assess current or future costs of a single project and would become redundant when compiled into a full, dated cost assessment. Moreover, this cost assessment would have allowed accountability between authorities. LB 1069 was possibly produced by a subordinate of the author of LB 1074 and LB 1078 who headed this archive. Numerical data would be drawn from reports like that of LB 1069 as well as surveys and assessments of the fields themselves and compiled into texts like LB 1074. Similar to the texts from the *Lu-igisa* archive, this text would possibly have been used to report to a higher institutional authority or an outside institution, perhaps a grain storage bureau, and would have been used for planning the following year's agricultural activity.

Texts which solely state costs but do not specify an accountable official probably reflect activity within one institution, whether a household or a bureau, and, when fully dated, could be used to report to an outside institution or authority. However, as Foster (1982a: 22) states, another role of accounting is to state responsibility which is seen in the lists as well. This is probably the case when a disbursement official (ba-zi), an accepting authority (*maḫārum*), delivery official or agent (mu-ku$_x$(DU)) or recipient (šu-ti-a/šu… ti), is mentioned. Perspective is suggested in these terms, which both help define the agency or actor producing the text as well as responsibility and accountability of a commodity between disbursement and receipt.

In lists, the word ba-zi, 'disbursement', appears in eight texts: two in which silver is the medium for assessing activity (YBC 08758 and Riftin 1937: no. 052) and six in which grain is the medium for assessing activity (YBC 05829, YBC 07211, YBC 05768, YBC 06216, AO 08461) (Tables 3.4 and 3.5).

Table 3.4 Simple lists

I. Text	II. Subject	III. Archive or bureau	IV. Scribe	V. Year	VI. Location
LB 1092	Various silver expenditures	Household	Scribe C	Reign of *Rīm-Sîn*?	Uncertain
LB 1091	Household costs in grain	Household	Scribe D	Reign of *Rīm-Sîn*?	Perhaps Larsa
Ashm 1924-453	Household costs in grain for two days	Household	Uncertain	No date	Uncertain

Table 3.5 Silver lists and grain lists

I. Text	II. Subject	III. Archive or bureau	IV. Scribe	V. Year	VI. Location
YBC 08758	Silver expenditures to individuals	Merchant intermediaries	*Gimillum*	*Rīm-Sîn* year 07	Larsa
Riftin 1937: no. 052	Silver expenditures for various purposes	Merchant intermediaries	*Gimillum*	*Rīm-Sîn* year 08	Larsa
YBC 05829	Bureau grain expenditures	Grain storage bureau	*Ubār-Šamaš*	*Rīm-Sîn* year 06	Larsa
YBC 07211	Bureau grain expenditures	Grain storage bureau	Scribe F	*Rīm-Sîn* year 07	Larsa
YBC 05768	Bureau grain expenditures	Grain storage bureau	Scribe F	*Rīm-Sîn* year 09	Larsa
YBC 06216	Bureau grain expenditures	Grain storage bureau	Scribe F	*Rīm-Sîn* year 09	Larsa
AO 08461	Grain expenditures	Household	Scribe N	*Rīm-Sîn* year 57 or 58	Larsa or Larsa area

ba-zi, 'disbursements', suggests the perspective of the issuing authority when it appears at the bottom of a list, alone or followed by a person's name.[11] Thus, a text with this word offers evidence that goods referred to are no longer under the authority of this actor or organization.

Riftin 1937: no. 052, attributed to the archive of *Gimillum* and dated to early in the reign of *Rīm-Sîn*, provides additional evidence that some merchant accounts were also part of a complex system used to assess excess capital in silver by means of merchant intermediaries, even early in the reign of *Rīm-Sîn* (see Sect. 3.1.2 above and Chap. 4). This text shows that *Gimillum* was not only the bureau head of

[11]Perhaps the use of ba-zi is similar to that described by Sallaberger (1999: 240) for the Ur III period, where it signifies the expenditure of finished products. As stated on (*ibid.*: 245), the person named as qualifying ba-zi, as well as mu-ku$_x$(DU) discussed below, was probably the institutional head or authority directing the activity described in the text.

a grain storage bureau as illustrated by YBC 05586, mentioned above, but also a merchant of some standing. Line 10 states, '*i-nu-ma u-bar-*^{d}Šamaš ugula dam-gar$_3$ u$_4$ 2(u)-kam *iš-ku-nu*', 'when *Ubār-Šamaš*, the merchant overseer established 20 days (of accounts)'. The silver itself, that is, 3 *gin* 14 *še*, is stated as '*ša* u$_4$ 2(u)-kam' 'for 20 days' (line 9) and the date of this expenditure is described as 'iti gan-gan-e$_3$ u$_4$ 2(u)-kam', the 20th day of the 9th month. *Ubār-Šamaš*' calculated expenses for twenty days and requested the silver due to him. This silver includes that provided by *Gimillum* in line 10 of Riftin 1937: no. 052. Because *Ubār-Šamaš* is acting as a crown official with the title merchant overseer, the silver that *Gimillum* is providing him with is, in fact, crown silver. This, as well as *Gimillum*'s potential involvement with the grain storage bureau, suggests that *Gimillum*, a merchant, also acted on behalf of, and received silver and capital from the crown. The merchant was a liminal figure then, acting between household administration and bureau administration where the bureau authority needed financing among other things. He acted as a source of silver for the crown in a similar manner as seen above in the *sūtu* texts (Sect. 3.1.2). Moreover, this text makes explicit that lists were compiled out of smaller accounts, whether single transactions or lists. It sums up numerical data produced in a prior accounting for later reference.

The word *maḫārum* appears in one particular list, AO 08524, which is dated to *Rīm-Sîn*'s fiftieth year in power. This text, part of the archive of *Sîn-rāmā*, describes the acceptance of grain by an official who is probably acting in the capacity of guarantor or conveyor (giri$_3$), an official who takes responsibility for goods between disbursement and delivery.[12] The use of the first person with this verb confirms with certainty that this text is written from the perspective of the guarantor. It can also be understood as a summary, compiling data from his acceptance of multiple consignments of grain and then future delivery of this grain. Thus, it is a report written to project a delivery based on data accumulated prior to shipment.

The term mu-ku$_x$(DU), delivery, is used in two lists, YBC 04761 and AO 08464, to state the destination, that is, the person or institution that ultimately receives a commodity.[13] This suggests that the text is written from the perspective of the incoming institution as opposed to the disbursing institution (Table 3.6).

The term šu… ti, used in two lists, HE 111 and YBC 07744, states who received goods on behalf of the incoming institution or person, as opposed to *maḫārum* which states acceptance in transit and mu-ku$_x$(DU) which states the incoming

[12]This individual probably acts similarly to his counterpart from the Ur III period, who, as described by Sallaberger (1999: 249–50), is employed when the place of origin of a commodity/goods is outside of the receiving institution. Veldhuis (2001: 94) states of this official in Ur III Girsu, 'From the point of view of the central administration, he is the middle man, ultimately responsible for the arrival of the goods at the correct place'.

[13]This is similar to the Ur III period, where the term is employed towards the end of a document to signify the delivery of goods to an institution. Cf. Sallaberger (1999: 240) for this, where the term describes the delivery of raw materials and then an institution's available credit.

Table 3.6 Silver delivery lists

I. Text	II. Subject	III. Archive or bureau	IV. Scribe	V. Year	VI. Location
YBC 04761	Deliveries of goods evaluated in silver	Merchant	Scribe B	*Nūr-Adad* year C	Perhaps Ur
AO 08464	Deliveries of goods evaluated in silver	Merchant intermediaries	*Itti-Sîn-milki*	*Rīm-Sîn* year 27	*Zarbilum*

institution or person.[14] AO 08464 states the incoming authority, *Itti-Sîn-milki*, and also describes two recipients on his behalf. While AO 08464 is written from the incoming authority's perspective, it was deemed important to state the persons who received the goods. AO 08464 thus confirms this distinction of recipient as against incoming authority. Moreover, activity described in AO 08464 is similar, although not the same, as disbursements and expenditures found in YBC 07473, which was produced by the same author as AO 08464. This offers the possibility that AO 08464 and other silver lists would be compiled into balanced accounts at a later date, for which see Sect. 3.1.4 below. The use of equivalencies and price statements to evaluate goods in all four texts suggests that each text estimates value in silver.

A kind of transit of goods and services is represented in the lists and even by the single transactions mentioned above. An institution disburses a commodity, which is accepted by an individual or group for transit, received at an institution, and then entered into this institution's own record by the authority in charge of this institution. A similar movement of goods is suggested by Van de Mieroop (1987: 88–92) for the city of Isin in the early Old Babylonian period. In this case an institution could be at the household level or a bureau administration, or a merchant acting between the two or on behalf of one or the other. This movement could be, and often was, summarized in the balanced accounts.

With each text, whether simple lists as described in Table 3.4 or silver recipient lists as described in Table 3.7, an official, whether a bureau official, household manager or merchant, compiled lists of data to summarize numerical data for future reference. Whether estimating value, as in the silver lists, or summarizing activity, lists were probably produced from records of single transactions, either from a written document at the time of the transactions, or possibly from memory. In turn, lists would probably be used by another official, or the same official at a later date, to sum up further activity, whether in another list or in a balanced account such as those described in the next section.

[14]Sallaberger (1999: 214) notes the use of this term to describe the receipt of goods within the same institution, while Steinkeller (2003: 38) states that this term is used primarily by smaller institutions to describe the receipt of goods. According to Steinkeller (*ibid.*: 38), 'Records of this type were prepared expressly for the expending or disbursing party, in whose possession they would remain either indefinitely or until they were transferred'.

Table 3.7 Silver recipient lists

I. Text	II. Subject	III. Archive or bureau	IV. Scribe	V. Year	VI. Location
HE 111	Deliveries of goods evaluated in silver	Merchant intermediaries	*Šēp-Sîn* B	*Samsu-Iluna* year 05	Larsa
YBC 07744	Deliveries of fish evaluated in silver	Merchant intermediaries	*Sîn-muštāl*	*Hammu-rābi* year 41	Ur or Larsa

3.1.4 Balanced Accounts

Balanced accounts have been variously treated by Cripps (2017), Ouyang (2013), Van de Mieroop (2004: 55–7), Hallo (2004: 96–98), Breckwoldt (1994: 121–156) and Snell (1982: esp. 53–4 for the Old Babylonian period). Snell (*ibid.*: 11), discussing Ur III balanced silver accounts, makes note of the term nig$_2$-ka$_9$-ak (which he transliterates as nig$_2$-šita-ag), the Sumerian equivalent of Akkadian *nikkassu epšu* discussed below, in the subscripts of Ur III balanced accounts. Although no balanced accounts for the period of *Hammu-rābi*'s rule over Larsa are studied here nor could be located in pursuit of this study, the use of this term in A.26378, dated to *Hammu-rābi*'s forty-first year in power, suggests the continued existence of such accounts into his reign.[15]

Balanced accounts typically consist of three main parts. The first part is a capital section, which is qualified by the word sag-nig$_2$-gur$_{11}$(-ra), 'capital'. This word appears at the conclusion of the capital section in prosaic texts as well as some tabular lists (LB 1075) and describes the capital column, column 1, in YBC 04721. The capital section describes what was available and needed to be accounted for. Following this was an expenditure section, often, though not always, commencing with ša$_3$-bi-ta, 'out of which,' and typically terminating with ba-zi, 'disbursed'. YBC 04721, presented above, is an exception to this: ša$_3$-bi-ta is not written, nor is it necessary due to the tabular layout of this text; the expenditures were obvious and qualified in the column heads. The expenditure section states deductions, and then a statement of difference marked by la'u$_4$, 'arrears', or diri 'surplus'. This difference statement always appears in silver accounts and occasionally on grain accounts,

[15]In contrast to Breckwoldt (1994: 82), where a distinction is suggested between the reign of *Rīm-Sîn* when balanced accounts were used, and the reign of *Hammu-rābi*, where *sūtu* texts were employed to administer the silver economy. Here it is suggested that with *Hammu-rābi* came a slightly different form of capital exploitation, the *sūtu* system, which added an additional layer of administrative complexity. Accounts still needed to be balanced, as the use of the phrase *nikkassu epšu* suggests.

Table 3.8 Silver balanced accounts

I. Text	II. Subject	III. Archive or bureau	IV. Scribe	V. Year	VI. Location
YBC 04224	Disbursement of goods evaluated in silver	Merchant intermediaries	Scribe A	*Gungunum*?	Larsa or Larsa area
YBC 07473	Disbursement of goods evaluated in silver	Merchant intermediaries	*Itti-Sîn-milki*	*Rīm-Sîn* year 04	*Zarbilum*
AO 06760	Disbursement of goods evaluated in silver	Merchant intermediaries	*Ubār-Šamaš*	*Rīm-Sîn* year 02	Larsa
AO 07034	Disbursement of goods evaluated in silver	Merchant intermediaries	Scribe G	*Rīm-Sîn* year 09	Larsa

Table 3.9 Grain balanced accounts

I. Text	II. Subject	III. Archive or bureau	IV. Scribe	V. Year	VI. Location
YBC 04721	Grain disbursements	Bureau of irrigation and excavation	*Šamaš-aššu-aplu*	*Rīm-Sîn* year 01	Perhaps Larsa
LB 1082	Grain disbursements	Household	Scribe H	*Rīm-Sîn* year 31	Perhaps near Isin
LB 1072	Grain disbursements	Household	Scribe H	*Rīm-Sîn* year 31	Perhaps near Isin
AO 08493	Grain collection and shipment	Household	*Sîn-rāmā*	*Rīm-Sîn* year 52?	Larsa
LB 3051	Grain disbursements	Household	*Aḫūšunu*	*Rīm-Sîn* year 59	Uncertain

while *sītum*, 'balance',[16] appears on LB 1075, a tabular economic text dated to *Rīm-Sîn*'s thirty-ninth year and attributed to perhaps a bureau administrator, *Sîn-iddinam*, active around or north of the city of Larsa.

According to Van de Mieroop (2004: 55) when describing Ur III period accounting, 'every office produced such records, as all accountants had to ascertain the balance of their area of responsibility: labor, animals, craft goods, whatever'. A similar situation existed in the old Babylonian kingdom of Larsa, at least up through the reign of *Rīm-Sîn* and probably into *Hammu-rābi*'s reign as well. Several varieties of these accounts with different purposes existed, based on the archive that produced them: silver accounts (Table 3.8), grain accounts (Table 3.9), a tabular accounting of bappir and salt (LB 1075) and grain shipment texts (Table 3.10).

[16]For this translation of *si-i*$_3$*-tum*, see the electronic Pennsylvania Sumerian Dictionary (ePSD), 2006, http://psd.museum.upenn.edu/epsd1/nepsd-frame.html. Accessed 19 July 2016. There it is related to the Akkadian word *šittum*, 'remnant'. Halloran (2006: 230) defines this term as 'balance owing carried forward from an earlier account, usually from the previous year (from Akkadian *šiātum*, 'to leave behind,' *šittu*, 'remainder, deficit')'.

Table 3.10 Grain shipment texts

I. Text	II. Subject	III. Archive or bureau	IV. Scribe	V. Year	VI. Location
YBC 05586	Grain shipment	Grain storage bureau	*Gimillum*	*Warad-Sîn* year 4a	Larsa
YBC 07310	Grain shipment	Grain storage bureau	Scribe E	*Rīm-Sîn* year 06	Larsa
YBC 07187	Grain shipment	Grain storage bureau	Scribe E	*Rīm-Sîn* year 06	Larsa
YBC 05494	Grain shipment	Grain storage bureau	Uncertain	*Rīm-Sîn* year 06	Larsa
Riftin 1937: no. 051	Grain shipment	Grain storage bureau	Uncertain	*Rīm-Sîn* year 06	Larsa
YBC 06985	Grain shipment	Grain storage bureau	Uncertain	*Rīm-Sîn* year 07	Larsa
YBC 06663	Grain shipment	Grain storage bureau	Uncertain	*Rīm-Sîn* year 06	Larsa
YBC 05580	Grain shipment	Grain storage bureau	*Ṣillī-Šamaš*	*Rīm-Sîn* year 07	Larsa
YBC 06231	Grain shipment	Grain storage bureau	*Ṣillī-Šamaš*	*Rīm-Sîn* year 08	Larsa
YBC 07194	Grain shipment	Grain storage bureau	*Ṣillī-Šamaš*	*Rīm-Sîn* year 12	Larsa
AO 06763	Grain shipment	Grain storage bureau	*Sîn-māgir* A	*Rīm-Sîn* year 07	Larsa
Riftin 1937: no. 054	Grain shipment	Grain storage bureau	*Sîn-māgir* A	*Rīm-Sîn* year 13	Larsa
YBC 08774	Grain shipment	Grain storage bureau	*Sîn-errēš*	*Rīm-Sîn* year 07	Larsa

Silver accounts are treated in Snell's and Breckwoldt's discussions for the Ur III and Old Babylonian periods respectively. Breckwoldt (1994: 154) suggests that these accounts were the personal records of merchants who belonged to the local merchant association. The capital referred to in these texts came from different sources, although part of it probably came from the unused surplus produced by the palace. This was given to the merchants as a long-term loan, similar to the *sūtu* accounts discussed above (Sect. 3.1.2), which were evaluated in silver at a rate agreed upon by both parties (cf. *ibid.*: 154). This agreed-upon rate was described by the term kar(-bi), '(its) rate' and fixed by the local merchant community (see Chap. 8 for this definition). Value would have been stated as ku$_3$-bi, 'its silver (value)'. Expenditures were expressed with silver equivalents, which were either the purchase price or an evaluation of the goods provided in silver. The difference, either excess or deficit, appears after expenditures and, as YBC 04224 shows, when this difference was a surplus it could be disbursed to individuals for investment.

These texts attest to the change to a silver economy mentioned above under single transactions (Sect. 3.1.2).

As noted in Table 3.8, each text belongs to the same system of merchant intermediaries as described in Chap. 1 and mentioned above (Sect. 3.1.2, with the possible exception of YBC 04224 based on date alone). The merchants who are behind each text are maintaining accountability by keeping track of received goods, evaluating them in silver and stating silver expenditures or their equivalent on behalf of the crown. Thus, the silver balanced accounts are records of prior transactions used by merchants to maintain accountability for a higher authority, the palace, to assist this authority in planning income and cost.

Grain balanced accounts appear in both tabular and prosaic form. Aside from YBC 04721, which was discussed above, each text described here seems to be part of a personal household archive describing household expenses and the activity of the archive's main actor in local or even state administrations. Tablets LB 1082 and AO 08493 reveal where the capital in the form of grain came from. In LB 1082 it is derived from the grain already stored (line 1) as well as from two places (lines 2 and 3), either the agricultural yield produced in these two places or stored grain qualified by line 1. In any event, capital in this record is already the property of the tablet's owner. AO 08493 describes the grain capital as revenue of 20 *gur* calculated by the king, given to the e-sikilli, which became the ration of *Sîn-rāma* (lines 1–8). That is to say, it was probably derived from a tax on temple land managed by the palace which was allocated to the rations of a local notable. Thus, grain is probably derived from either temple or palace income as well as property already in personal ownership.

Expenditures are presumably household expenses or labor. This is especially evident with AO 08493, which lists a cultic meal at the time of a death (lines 19–21), a doctor's fee (line 26–29), care for a pregnant woman (line 30) and for the account holder when he was sick (32-3). LB 1082 lists both grain provided to a diseased woman (7–8) and household rations (12) as expenditures. LB 1072 lists both household rations (line 3) and food (7) as reasons for expenditures.

LB 3051 is somewhat different. It presents allocations to various individuals and then states as a reason 'toward water to irrigate' in lines 12 and 22, as well as boat wages in line 2, porters in line 5 and the fee for a house in line 24. It is understood here as presenting the cost of preparing a field and then transporting grain in agricultural production. The small scale of it, only 13 *gur* capital in total, suggests this was part of a household's field preparation, although it could also be part of the accounts for a temple or palace estate. Whether referring to public or personal activity, LB 3051 is assumed here to be the product of a personal household archive similar to the *Lu-igisa* archive. The personal nature of this archive is especially suggested by the absence of an explicitly stated difference between the total and expenditures.

Difference between capital and expenditures is not always stated when grain is concerned. This is clear in the case of LB 3051. LB 1082 does not state a deficit. However, expenditures made beyond the capital are stated after the total of expenditures, suggesting these were drawn from an outside source. Thus, difference

is expressed by where expenditures appear in LB 1082. Lack of an explicitly stated balance suggests both of these texts are part of personal household archives. While these texts are suggested to be parts of personal household archives, they seem to have been constructed similarly to the silver balanced accounts summed up in Table 3.8. They sum up already completed transactions, both the collection of capital and expenditures from this capital. The chief difference is that these texts were not drawn up for an outside institution. They were meant to assist the head of the household in planning his own activities.

LB 1075, a balanced account in tabular format, lists both capital and expenditures in bappir and salt, as well as a balance (*sītum*). This text shows that not all tabular accounts necessarily describe grain or silver transactions.

A final group of texts provides information on grain transportation as described by Breckwoldt (1995/1996, especially 66–67) and comprises what is called the grain storage bureau in the present volume. These texts take the form of balanced accounts in which the amount shipped makes up the capital, often with a geographical name in line 2 and occasionally with mu-ku$_x$(DU) followed by a personal name. The expenditure section states the delivery to one or several storage facilities (mu-ku$_x$(DU) followed by a place name), the transport costs and then a total of grain followed by the phrase 'delivered and disbursed', (mu-ku$_x$(DU) *u*$_3$ ba-zi). After this is a difference qualified by the word la'u$_4$, 'arrears', then a listing of officials who guaranteed delivery (giri$_3$) and finally a date formula including month, day and year.

There are several interesting aspects in these texts. First, a place name is often stated, while a destination authority may also appear, qualified by mu-ku$_x$(DU), 'delivery of', rather than a recipient who would be qualified by šu-ti-a, 'receipt of', which is more typical of silver texts. The capital section describes a debit, an outgoing quantity, not a receipt. It can state the origin of grain debit and, when mu-ku$_x$(DU) is explicitly mentioned, the destination of this debit. Next, the entire expenditure section is qualified by the phrase mu-ku$_x$(DU) *u*$_3$ ba-zi, 'delivered and disbursed'. The expenditure section probably states a completed transaction—delivery has been made and accounted for. Difference is stated after this, possibly showing that accountability was verified by remeasurement (see Sect. 7.2 for this). Finally, the officials responsible for transit are noted, perhaps to verify that they are no longer accountable.

These texts are possibly the result of the same double entry bookkeeping system described by Hallo (2004). If so, grain was probably assessed at the time of shipment and two texts were produced. The first was a quantity of grain, the total to be shipped, drawn up by a representative of the bureau who carried this tablet back to the bureau or sent it via an assistant. This document would be represented by the capital description of the balanced account. Statement of origin and delivery were often necessary because multiple origins existed outside of the city of Larsa while multiple storage points existed within the city of Larsa. A second text was drawn up at the same time and given to the guarantors who arranged for delivery. Upon arrival, deductions reflecting transportation costs were made from this amount of grain and the total delivered was assessed to verify delivery. This is represented by

the expenditure section. The whole completed account was then drawn up stating the original amount sent, that is, the debit, the amount that arrived and the costs incurred, the credit, and then the difference, the balance. With this understanding, the appearance of mu-ku$_x$(DU) *u*$_3$ ba-zi is especially important and, following Hallo (2004), one could easily understand this as 'debit and credit'. Indeed, Hallo (*ibid.*: 96–98) notes that in the Ur III period balance sheets take the form of balanced accounts, listing completed transactions for the entire month as well as the remaining balance. Unfortunately, this must remain hypothetical because the grain delivery texts lack firm provenance and so there are no additional debit or credit texts associated with this evidence.

Balanced accounts of all kinds were a third level of organization in bureau, merchant and personal household archives. They, like single transactions and lists, take already obtained numerical data and organize it to help in administering an institution. With the silver texts produced by merchants and the grain shipment texts produced within a bureaucratic setting, they are created for use by a higher authority, whether within or outside of the same institution. As is seen with YBC 05586, the bureaucrats producing these texts in the grain storage bureau could be merchants, although this was not necessarily the case for all officials working in the grain storage bureau (see Sect. 4.1). In the case of the grain balanced accounts, administration was done within the same household and so the official drawing these texts up was probably the head of the household himself or a manager of his estates. Thus, it is not certain that these texts would be used by a higher official. However, all texts were important in assessing current capital in silver and grain (or bappir and salt as is the case with LB 1075) and then planning future activities with what was on hand and what could be expected.

3.2 Conclusions

Returning to the questions posed above at the very beginning of this chapter, 'how can the texts be defined'? and 'how are they related to each other'? there are three primary varieties of texts exhibited in this study: single transactions, lists and balanced accounts. These were compiled using prosaic and tabular formats, the latter of which could appear as tabular lists and formal tables.

Beyond this simple threefold distinction of texts and format, a variety of texts existed which corresponded to the various administrative practices in operation in the kingdom of Larsa in the early Old Babylonian period. These systems often, though not always, incorporated all three varieties of texts, that is, single transactions, lists and balanced accounts. First, an accounting system similar to one developed in the Ur III period existed in the kingdom of Larsa, which allowed for overseeing goods produced and utilized by a palace or temple bureau or workshop, a system similar to modern double entry bookkeeping. This was proposed for the daily or weekly lists used in various households, as well as the balanced accounts used in the grain storage bureau. Another system of accounting, also developed in

the Ur III period, was used to assess productivity and labor output of a household or bureau, as well as to maintain accountability within and between several households or bureau archives. This second system is suggested by the lists of the *Lu-igisa* archive.

Two systems of organization appear to have administered the assessment of goods produced on temple or palace lands using silver on behalf of the palace. The first system appeared in the silver balanced accounts dating to the reign of *Rīm-Sîn* and prior to this. The second system was evident in the *sūtu* texts, which record both single transactions and lists, and appeared during the reign of *Hammu-rābi*.

Third, another system attested in all three varieties of text was developed to produce and use grain, the second commodity desired by the palace, as stated by Stol. This system was heavily dependent on the use of private individuals and personal households. Personal households are evidenced by the grain balanced accounts described in Table 3.9, as well as the simple lists presented in Table 3.4. Thus, while texts tend to have similar forms and functions, there are remarkable differences between archives based on the needs and desires of the different actors. This means three levels of organization existed: personal household archives, institutional archives such as bureaus, and merchant archives.

The purpose of all the texts discussed here, and all the systems mentioned, was to state already obtained numerical data to administer and expand specific personal or institutional interests, whether those of a personal household, a merchant, or a state or temple bureau. All three text types, single transactions, lists or balanced accounts, were produced to this end. Single transactions often stated potential but incomplete transactions that were expected and which, if and when completed, were summarized in lists or balanced accounts. In a personal household, one individual could have produced all the text types while working in a large bureau, and each text type could have been produced by a different bureaucrat in a fixed hierarchy. Moreover, an archive did not necessarily use each variety of text. In this way accountability and responsibility was maintained within a bureau while individuals acting on behalf of the various bureaus and workshops could report necessary details to higher officials within or outside of their own administrations. The next chapter will examine the various bureaus and archives that make up this study.

Chapter 4
Archives, Bureaus and Management Systems in the Kingdom of Larsa

Abstract Building on Chap. 3's text discussion, this chapter describes bureaus and bureau archives from the kingdom of Larsa that appear in this volume. This chapter asks 'what do the texts studied here tell us about the environments in which they were produced'? Its purpose is to outline tacit knowledge about administrative structures that may have affected each scribe's mathematical reasoning. Thus, the difference between bureaus, bureau archives and then personal and merchant archives are explored. Examples are given of each, including a description of actors such as Gimillum, Sîn-muštāl and Ili-iddinam, all of whom were active within the bureaus or as notables in their own rights. Four bureaus and bureau archives are introduced: a grain storage bureau, a bureau of irrigation and excavation, a grain harvest archive and a grain production archive. This chapter is supplemented by Appendix 2, a study of numeracy among the scribes who populated these bureaus and bureau archives, as well as all scribes who authored texts presented in this volume.

Economic texts were produced to maintain accountability and responsibility, while reporting already obtained numerical data to a higher authority. They must, then, be able to tell us something about the people and institutions maintaining accountability and responsibility. They must, to a greater or lesser degree, reveal something about the authorities to whom they report. This chapter, supplemented by Appendix 2, examines these authorities and individuals active in the economic texts, asking 'what do the texts studied here tell us about the environments in which they were produced'? The purpose of this question is to outline tacit knowledge about administrative structures that may have affected each scribe's mathematical reasoning. However, before moving on, it will help to clarify the question, 'what is meant by an archive'?

An archive is understood here as a collection of texts centering around and providing information on the activities of a person, place or institution. They take the form of those outlined in Sect. 1.3: personal household archives, merchant archives and bureau archives. An example of a personal household archive is that of *Gimillum* (Appendix 2.G). These are archives because they center around and

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provide information on the activities of one household—in this case that of a notable, a man called *Gimillum*. There are several difficulties in constructing an archive around this individual: As outlined in Appendix 2, it cannot be stated with certainty that there is one single *Gimillum*, nor how many scribes were in his employ, because his name is spelled in multiple ways, he has multiple titles and he acts in different capacities.

Merchant archives center around and provide information on an individual, the merchant, who had a unique role in Mesopotamian society. As Van de Mieroop (2002: 84) states concerning the role of the merchant in Mesopotamia, 'these men were able to turn one commodity into another one, barley into silver, silver into exotic foreign products, and so on. The ability to do this is what defined the Mesopotamian merchant'. With this in mind, during the Old Babylonian period, many of the texts that make up merchant archives are part of a system in which merchants, members of the local *kārum*, act as intermediaries on behalf of the temples and crown, assessing excess capital or grain owned or controlled by the temples and crown in silver or labor—hence the phrase 'merchant intermediaries' used throughout this book.[1] The texts these merchant intermediaries produced often look like silver texts, especially balanced accounts, or *sūtu* texts, both of which are discussed in Chap. 3 above. While the texts take different shapes, the merchants' essential function remained the same between the reigns of *Warad-Sîn* and *Rīm-Sîn* and then under the reigns of *Hammu-rābi* and *Samsu-iluna*. However, it is difficult to tell if organization is the same between administrations. Multiple scribes and authors were active within this system of administering a complex economy and could easily act as household administrators as well as bureau administrators.

Sîn-muštāl, to whom YBC 07744 is attributed, can stand as an example of a merchant studied here (Appendix 2.LL). In YBC 07744, a series of transactions are laid out in which fish, stated as the property (nig$_2$-šu) of *Sîn-muštāl* the merchant overseer of Ur, is assessed in silver and given to *Watar-Šamaš* the overseer of 5 from *Iturram*, the overseer of *Ilī-iddinam*. In this text, then, crown capital is assessed in silver, described as the property (or better under the authority) of the merchant overseer of Ur and handed out to another merchant, the overseer of 5, by a further merchant.

Finally, four different bureaus or bureau archives are noted in the texts and designated here as the grain storage bureau, the bureau of irrigation and excavation, the grain harvest archive and the grain production archive. This chapter focuses on these four administrative structures. Bureau archives were often produced by multiple scribes who may have been active in other areas and these archives can be spread out over long periods of time or describe only a few months' or even days' activities. Thus, while only three different texts are presented in the grain production archive, it is suggested that there are two different individual scribes, active

[1]This is well described for the city of Ur by Van de Mieroop (1992: esp. part 2 and 241–250). For more on this system, see also Charpin (1980: 128ff.), Stol (1982), Breckwoldt (1994: 157–74), Rede (2005) and Földi (2014).

in years thirty-two and thirty-five of *Hammu-rābi*'s reign respectively. However, at least eight different scribes were active in the grain storage bureau from at least *Warad-Sîn* year 4a to *Rīm-Sîn* year thirteen. This begs the question of the distinction between a bureau archive and the bureau itself.

Two factors make up this distinction. The first is that of focus: the grain production archive is considered a bureau archive because it centers around and provides information on only one administrative activity, the production of grain, while the grain storage bureau centers around and provides information on multiple administrative activities. It describes the gathering of harvested grain from the city of Larsa's hinterland to a central point in Larsa where it is stored, and then the distribution of this stored grain for various purposes. A second difference is that of hierarchy: the grain production archive is a bureau archive because hierarchy is ambiguous; in two different years just two actors hold one office that focuses on one administrative activity. The grain storage bureau, however, has a clearly defined hierarchy of multiple actors whose offices are concerned with various administrative activities. These actors, moreover, may have archives of their own—whether they are household archives or merchant archives. This is the case with *Gimillum* described above.

It is not always a simple process to assign a text to an archive or a scribe working within an archive. For example, YBC 06216, dated to *Rīm-Sîn's* ninth year in power and possibly of the grain storage bureau, is described here as a day account of distributions for an unnamed household and can be connected to YBC 07313 based on the personal names: *Ḫuppātum* (line 3), *Puṭram-ilī* (line 4), *Zababa-mušallim* (line 5) and *Atannaḫ-ilī* (line 6) all appear, as well as a withdrawal for the household (lines 1–2). One suspects that the same scribe, described here as scribe F (Appendix 2.R), produced both texts. However, the nature of the household is not stated. The word household, *bītum*, is ambiguous. Is it a personal estate, a temple or palace administration, or something else? The texts themselves do not help. They both list only the names of individuals and the statement of the withdrawal for the household, so that the nature of labor provided by the actors receiving grain is uncertain. This is not an archive built around a named person, an administration or a variety of transaction, but it necessarily follows the scribe himself.

Thus, there are three kinds of archives. Personal household archives follow an individual who may be active in several areas of society. He may be active in a bureau, such as scribes active in the grain storage bureau like *Gimillum* and scribe F. These bureaus made up a second archival level, that of the local state or temple administration. Bureau archives were used on a local level to administer temple or state interests in the local economy and, as suggested by Van de Mieroop (1987, 1992), were possibly administered by local citizens. Actors in personal household archives could also produce merchant archives as well, such as the merchant intermediaries who assess excess capital in silver values on behalf of the crown. This level of organization bridged local administration and regional administration. This dichotomy makes a distinction as well between internal archives within a person's household, those active in a bureaucratic setting and those acting as an intermediary between governing authorities or on behalf of a governing authority to procure

labor and capital. This distinction also reveals variations in administrative practices as well as a centralizing tendency: local notables had their own archival practices but, when acting in local administrative structures, conformed to local scribal practices, and when acting with the state conformed to regional scribal practices. Appendix 2 presents a scribe by scribe discussion in order to provide a framework for numeracy by scribe. With this background, we can now present bureaus and bureau archives.

4.1 The Grain Storage Bureau

Gimillum, *Ubār-Šamaš*, scribe E, *Sîn-errēš*, *Sîn-māgir*, *Ṣillī-Šamaš*, scribe F and possibly scribe G are active in what is called the grain storage bureau here. They are possibly merchants like local merchant overseer *Ubār-Šamaš*, or notables like *Gimillum*, acting as head of this bureau. If so, a hierarchy can be seen in this bureau: overseers of merchants and other local notables who act as merchants head the bureau. They supervise the local merchant community and other notables who oversee collection and delivery of grain. Delivery is carried out by giri$_3$ officials who act as guarantors and take responsibility for the grain's transport (Table 4.1).

This three-tiered system is already suggested by Breckwoldt (1995/1996: 69–71). According to her, the bureau is clearly organized into two main actor categories: the delivery agents who supervise (*ibid.*: 69–70) and the giri$_3$ officials who arranged transport (*ibid.*: 70–71). In addition, an official in charge of the entire system possibly oversaw the delivery agent (*ibid.*: 70). Breckwoldt, however, sees little evidence for the officials who control the system. She notes a series of letters addressed from *Ṣillī-Šamaš* to 'my lord'[2] which implies an official overseeing the grain storage bureau. In particular, she sees the letter AO 06734 line 17 as providing evidence for someone who was in charge of this bureau. There she translates 'the grain from *your dimtum*' (Breckwoldt's italics, *ibid.*: 70). Breckwoldt (*ibid.*) suggests that this *dimtum* was Anzagar-Balamunamḫe, the owner of which may have been the notable Balamunamḫe.

This synthesis fits well with the system outlined above. Merchants, overseers of merchants such as *Ubār-Šamaš* or local notables such as the judge and brother of Balamunamḫe, *Gimillum*, supervised the local merchant community as well as notables who are active in the bureau. They were the ones ultimately responsible for collection and then disbursement of grain. Interestingly, YBC 05586, dated to *Warad-Sîn*'s fourth year in power and considered part of the archive of *Gimillum*, shows that *Gimillum*, along with the temple of Šamaš, received multiple grain

[2]Jean 1926, nos. 001-010; AbB 1 90; AbB 9 49 and AbB 9 94.

Table 4.1 Texts and actors in the grain storage bureau

Author	Position in bureau	Texts	Dates
Gimillum	Bureau head	YBC 05586	*Warad-Sîn* year 4a
Ubār-Šamaš	Bureau head	YBC 05829	*Rīm-Sîn* year 06
Scribe E	Delivery agent	YBC 07187	*Rīm-Sîn* year 06
	Delivery agent	YBC 07310	*Rīm-Sîn* year 06
Uncertain	Delivery agent	Riftin 1937: no. 051	*Rīm-Sîn* year 06
	Delivery agent	YBC 05494	*Rīm-Sîn* year 06
	Delivery agent	YBC 06663	*Rīm-Sîn* year 06
	Delivery agent	YBC 06985	*Rīm-Sîn* year 06
Sîn-māgir	Delivery agent	YBC 07195	*Rīm-Sîn* year 06
	Delivery agent	AO 06763	*Rīm-Sîn* year 07
	Delivery agent	Riftin 1937: no. 054	*Rīm-Sîn* year 13
Sîn-errēš	Delivery agent	YBC 08774	*Rīm-Sîn* year 07
Ṣillī-Šamaš	Delivery agent	YBC 05580	*Rīm-Sîn* year 07
	Delivery agent	YBC 06231	*Rīm-Sîn* year 08
	Delivery agent	YBC 07194	*Rīm-Sîn* year 12
Scribe F	Bureau head?	YBC 07211	*Rīm-Sîn* year 07
	Bureau head?	YBC 07308	*Rīm-Sîn* year 09
	Bureau head?	YBC 05768	*Rīm-Sîn* year 09
	Bureau head?	YBC 06216	*Rīm-Sîn* year 09
	Bureau head?	YBC 07313	*Rīm-Sîn* year 10

shipments. These shipments are combined into one large list of balanced accounts on YBC 05586. The first shipment is delivered by *Sîn-errēš*, described as the man of Umma and perhaps the same notable as is charged with delivery in YBC 08774 dated to *Rīm-Sîn* year seven. *Damqum* acts as conveyor, the giri$_3$ official. The remaining shipments are transported either by the carpenter or *Ṣillī-Šamaš* and *Awīl-Amurru*, all three acting as giri$_3$ officials, that is, conveyors. Three parties are, then, active in this text: a recipient and probably the text's author and head of the bureau, a delivery agent and several persons acting as conveyors (giri$_3$ officials).

In the end, out of 10 × 60 + 1×60 + 9 *gur* grain shipped, *Gimillum* receives the bulk, amounting to 9 × 60 + 18 *gur* 3 *bariga*. The Šamaš temple only receives 1 × 60 + 41 *gur* of grain. The remaining balance is used to defray costs or appears as the difference. Perhaps AO 06734, mentioned above, can help to explain YBC 09774. In AO 06734, *Gimillum*, brother of Balamunamḫe, is overseeing grain on behalf of his brother, and thus acting in a semi-official capacity similar to the merchant overseer. AO 06734 is written by *Ṣillī-Šamaš* who acts as conveyor.

The grain is stored in the storehouse of the temple of Šamaš or in the household of the bureau head himself, here *Gimillum*. Indeed, grain is stored in multiple locations according to all the texts[3]:

new storehouse of Broad-Street ($arah_4^!$ *ša* sila-dagal-la gibil): YBC 07310: 4-5

storehouse, household of *Mâšum* (e_2 kišib-ba e_2 *ma-a-šum*): YBC 06663: 5

sealed storeroom of the house of *Tarībum* (e_2 kišib-ba e_2 *ta-ri-bu-um*): YBC 07187: 4

sealed storeroom of the new Broad Street house (e_2 kišib-ba e_2 sila dagal-la gibil): YBC 05494: 6, YBC 08774: 5

sealed storeroom of the new Broad Street house (e_2 kišib-ba e_2 sila-gid_2-da gibil): YBC 06231: 7

sealed storeroom in the new house on Broad Street (e_2 kišib-ba $ša_3$ e_2 sila dagal-la gibil): Riftin 1937: no. 054: 6-7

storeroom of the new Broad Street house new threshing floor (e_2 ki-gal-$_2$ gibil sila-dagal-la gibil): YBC 07194: 6

sealed storeroom of the house (e_2 kišib-ba e_2): YBC 06985: 6

sealed storeroom of the new storehouse (e_2 kišib-ba $arah_4$ gibil): YBC 05580: 6

sealed storeroom of the new granary (e_2 kišib-ba e_2 *a-ša-aḫ-ḫa-tim* gibil): AO 06763: 7

Not a single delivery is made directly to a temple or large institution. Two texts list the name of a household in which the grain is stored, YBC 06663 and YBC 07187, while the remainder simply state grain is stored in the storeroom or storehouse of a house (hold). It is difficult to ascertain whether these are public or private storehouses, although based on *Gimillum*'s summary account, YBC 05586, it is possible that most storehouses were private storehouses contracted by or owned by the administrator in charge of this bureau. Thus, the new house on Broad Street (or the new Broad Street house) of Riftin 1937: no. 054, YBC 05494, YBC 06231, YBC 06985, YBC 07194, YBC 07310 and YBC 08774 would probably be a private establishment.

Evidence from outside of this bureau suggests grain may have been shipped in sacks, perhaps containing a *bariga* or some other capacity measurement value that one man could carry alone. Seal impressions from the Uruk period of the fourth millennium depict workers either packing sacks or carrying sacks up a ladder to empty their contents into a granary (Paulette 2016: 88). Several texts dating to the Ur III period describe workers loading grain into sacks to be shipped by boat from a variety of locations to a granary or storehouse at Garšana (Heimpel 2009: 208–316). Finally, Breckwoldt (1995/1996: 65–66) herself suggests grain may have been stored in standardized sacks within some granaries or storerooms.[4] This is all, however, conjecture because there is no statement of how grain was delivered or stored.

[3]For these various storage facilities, see (*ibid.*: 75).

[4]Breckwoldt bases her assumption that grain was stored in standard sacks of perhaps 1 *bariga* on a single letter about the theft of 2 *bariga* grain in a grain storage facility (AbB 6, 219). In her view, the theft could only have been assessed if grain were stored in bags or the person reporting the amount stolen was in collusion with the thief. However, one could also hypothesize that the servant girl had simply eyeballed the stolen amounts, an official assessment had taken place, or that

Ubār-Šamaš is described as a merchant overseer, possibly of Larsa, in Riftin 1937: no. 052 dated to *Rīm-Sîn's* eighth year in power and belonging to the archive of *Gimillum*. In AO 06760, a balanced account dated to *Rīm-Sîn* year two, this merchant is already expending silver, probably on behalf of the crown, to officials such as *Ṣillī-Šamaš*. Perhaps *Ubār-Šamaš* heads the grain storage bureau in YBC 05829, dated to *Rīm-Sîn's* sixth year in power, where disbursements are made from the storeroom of the new house on Broad Street (line 24). The text describes grain allocations from this central location in Larsa for use in a construction project at, or in, the environs of the city of Ur. If *Ubār-Šamaš* does lead this bureau, then this would be an instance of a merchant overseer disbursing grain stored in Larsa to construction projects outside of Larsa.

YBC 05829 is not the only text in which grain is disbursed. YBC 05768, YBC 06216, YBC 07211, YBC 07308 and YBC 07313 are attributed to scribes, perhaps a bureau head, whether a merchant overseer or otherwise, indeed maybe even *Ubār-Šamaš* if he was still head of this bureau in the seventh through ninth years *of Rīm-Sîn's* reign. Thus, grain from Larsa funds the delivery of straw in YBC 05768 and of bricks in YBC 07308. With YBC 06216 and YBC 07313 possibly attributed to this bureau as well, it is distributed among various individuals. It seems that the head of the grain storage bureau held some clout, overseeing personnel wages, delivery of construction materials and even construction, not only in the city of Larsa but throughout the kingdom of Larsa.

YBC 07195 and YBC 07211 offer an important bridge between the grain storage bureau head and the delivery agents. YBC 07211 lists grain allocations and distributions to several towns: *al-Sîn-nur-matim* in line 7, *al*-KAAN and Anzagar-Balamunamḫe in line 13, *al-Širimtum* in line 19 and *Bad-dīḫûtum* in line 26. In YBC 07211, multiple grain disbursements are made for various reasons based on the needs of each community. These are, by and large, agricultural disbursements to all towns but *Bad-dīḫûtum* which fashions and ships bricks.

YBC 07195, attributed to *Sîn-māgir*, is different from YBC 05829 as well as YBC 05768, YBC 06216, YBC 07211, YBC 07308 and YBC 07313 in that it is a balanced account, not a list. YBC 07195 reports grain allocations to two villages, *al-Iškun-Ea* and *al-Abī-sarē*, carried out over a three-month period. These include agricultural activities around the town as well as delivery costs for delivering straw and other materials, and wages for personnel. The remainder is then brought to an undisclosed location from the village. This may relate to AO 06763 and Riftin 1937: no. 054, also attributed to *Sîn-māgir*, and suggests that these excess remainders made up at least part of the deliveries to the grain storage bureau. Moreover, because of the town names mentioned, and because this grain is withdrawn from a household granary, just like the destination of grain in the delivery texts, the source of grain was probably the city of Larsa and the grain storage bureau itself in YBC 07211. Thus, grain was stored at Larsa and disbursed to the

the thief had been caught and confessed. On the other hand, grain did have to be stored, and standardized sacks do provide a plausible means to store grain.

local villages for production of next year's crop, the remainder to be returned to Larsa with the surplus crop. *Sîn-māgir*, a delivery agent, was responsible for these activities, or at least the grain involved in these activities. This would fit well with Breckwoldt's summary (*ibid.*: 70) of delivery agents: 'It seems possible that these men spent some time in the towns where they would assess the harvest, manage grain expenses: they decided what amounts were needed locally and what amount (s) could be sent to Larsa'. In the texts of both YBC 05829 and YBC 07211 grain is allocated to towns for agricultural use and local consumption. In YBC 05829 the bureau head possibly allocates this grain, while YBC 07211 shows that the delivery agent managed this grain. Within the bureau, there are at least four delivery agents visible in the texts, in addition to the two heads suggested above.

The giri$_3$ official is responsible for grain while in transit: 'The agents managed the assessment, packing and shipment of the grain, the conveyors effected the transport' (*ibid.*: 70). As Breckwoldt (*ibid.*: 71) suggests, the giri$_3$ officials were not necessarily of the same profession. She notes the case of *Šarrūt-Sîn*, a conveyor in YBC 06231, who receives 20 *gur* grain as a boat handler from the sealed storeroom of the new Broad Street house (e$_2$ kišib-ba e$_2$ sila dagal-la gibil) in Jean 1926: no. 025. In addition, she suggests that several conveyors were also merchants. She points out (*ibid.*) that several officials of the grain storage bureau acted as conveyors in this bureau while they appear as merchants elsewhere: *Gimillum* in YBC 07227 and dated to *Warad-Sîn's* twelfth regnal year, who is active in Riftin 1937: no. 051 as a conveyor, or *Lāqipum* in Riftin 1937: no. 025, dated to *Rīm-Sîn* year fifteen, who is a conveyor in YBC 05580, AO 06763 and YBC 08774.

The activities of *Gimillum* and *Ṣillī-Šamaš* show mobility within the bureau itself. As noted above, *Gimillum*, brother of Balamunamḫe, is suggested to act as bureau head, or at least on this head's behalf, in YBC 05586, dated to *Warad-Sîn's* fourth year, where he sums up multiple deliveries of grain to the temple of Šamaš and then to himself, possibly as a crown official although this is not stated. As noted by Breckwoldt, this same individual is active as a merchant in *Warad-Sîn's* twelfth year. In Riftin 1937: no. 051 dated to *Rīm-Sîn's* sixth year in power, *Gimillum* is a conveyor. Finally, in Riftin 1937: no. 052 dated to *Rīm-Sîn's* eighth year, he is seen expending silver to or acting on behalf of *Ubār-Šamaš* while *Ubār-Šamaš* is a merchant overseer. We then see him acting as the head of the bureau in *Warad-Sîn's* reign but by *Rīm-Sîn's* sixth year he is only a conveyor, while *Ubār-Šamaš* is acting as head of the bureau, if YBC 05829 is correctly interpreted. Within the bureau itself, *Gimillum* is downwardly mobile, perhaps reflecting less bureau involvement and greater concentration on his own matters as a merchant and judge.

Ṣillī-Šamaš acts in multiple capacities as well, all under the supervision of *Gimillum* or *Ubār-Šamaš*. First, in AO 06760, a balanced silver account dated to *Rīm-Sîn* year two, he is one of several recipients of silver or goods evaluated in silver from *Ubār-Šamaš*. In YBC 05829, where it is suggested *Ubār-Šamaš* acts as bureau head, *Ṣillī-Šamaš*, described as the son of *Simmugra*, is one of several

recipients of grain. It can be inferred from this that he is a mid-level bureaucrat in the administration of Larsa who is able to draw on state silver and grain. Prior to this, in YBC 05586, he is acting under *Gimillum* as a conveyor of grain in at least two transactions. As noted above, *Ṣillī-Šamaš* addressed someone as 'my lord' when referring to their *dimtum* and this person may have been Balamunamḫe or one of his brethren, such as *Gimillum*. However, in YBC 05580 and YBC 07194 he acted as the delivery agent in *al-Sîn-nūr-mātim* during *Rīm-Sîn* years seven and twelve, while he was in Anzagar-Balamunamḫe as delivery agent in *Rīm-Sîn's* eighth year. He was certainly upwardly mobile, increasing his involvement with the bureau.

The career of *Ṣillī-Šamaš*, acting both within the bureau and as a recipient of grain and silver from *Ubār-Šamaš*, helps support the hypothesis that *Ubār-Šamaš* was overseer of the grain storage bureau by the reign of *Rīm-Sîn*. *Ubār-Šamaš*, a merchant overseer, is expending silver to *Ṣillī-Šamaš* in AO 06760 and grain to him in YBC 05829, in the same period that *Ṣillī-Šamaš* is acting as either a conveyor or delivery agent for this bureau in the texts. Indeed, YBC 05829 shows grain disbursed by *Ubār-Šamaš* from the storeroom of the new house on Broad Street, the destination of multiple grain deliveries as shown above. *Ubār-Šamaš* is, then, relatively firmly associated with this bureau as its head by *Rīm-Sîn's* sixth year so that *Ṣillī-Šamaš* worked in this bureau under at least two bureau heads: he was a conveyor under *Gimillum* and then a delivery agent under *Ubār-Šamaš*.

The following helps to break down activity by location and then by individual in the grain storage bureau. With the first chart, each town where deliveries originate is listed along with texts these deliveries appear in. This is followed by the suggested bureau head, the delivery agents in the texts and the conveyors, each listed with the text they are found in. In the second chart, each official is listed, broken down by position in the bureau, texts he is listed in and the location he is active in with each text.

al-MAŠ-ZI: YBC 05586 (*Warad-Sîn* year 04)

Bureau head:	*Gimillum*
Delivery agent:	*Sîn-errēš*
Conveyors:	*Awīl-Amurru* *Damqum* *Ṣillī-Šamaš*

al-Idi-Uraš: YBC 05586 (*Warad-Sîn* year 04)

Bureau head:	*Gimillum*
Conveyors:	*Ibašsi-ilum* *Erra-bani*

Anzagar-Balamunamḫe: YBC 07211 (*Rīm-Sîn* year 07), YBC 06231 (*Rīm-Sîn* year 08)

Bureau head:	*Ubār-Šamaš*?
Delivery agent:	*Ṣillī-Šamaš* YBC 06231
Conveyors:	*Awīl-Ninšubur* (*ka*) YBC 06231 *Ea-nāṣir* YBC 06231 *Ilšu-bani* YBC 06231 *Mannum* YBC 06231 *Nūr-Amurru* YBC 06231 *Sîn-iddinam* YBC 06231 *Šarrūt-Sîn* YBC 06231

al-Abī-sarē: YBC 06663 (*Rīm-Sîn* year 06), YBC 07195 (*Rīm-Sîn* year 06)

Bureau head:	*Ubār-Šamaš*?
Delivery agent:	Uncertain YBC 06663 *Sîn-māgir* (A) YBC 07195
Conveyors:	*Apil-Sîn* YBC 06663 *Nūr-Amurru* YBC 06663 *Sîn-apil-Enlil* YBC 06663 *Sîn-qāti-ṣabat* YBC 06663

al-Sîn-nūr-mātim: Riftin 1937: no. 051 (*Rīm-Sîn* year 06), YBC 07195 (*Rīm-Sîn* year 06), YBC 05580 (*Rīm-Sîn* year 07), YBC 07211 (*Rīm-Sîn* year 07), YBC 07194 (*Rīm-Sîn* year 12)

Bureau head:	*Ubār-Šamaš*?
Delivery agent:	*Sîn-māgir* (A) YBC 07195 *Ṣillī-Šamaš* YBC 07194, YBC 05580
Conveyors:	*Apil-Sîn* YBC 07194, YBC 05580 *Awīl-Ninšubur* (*ka*) YBC 07194 *Gimillum* Riftin 1937: no. 051 *Ilšu-bani* Riftin 1937: no. 051 *Lāqipum* YBC 05580 *Sîn-qāti-ṣabat* YBC 05580 *Ubarrûm* Riftin 1937: no. 051

al-Iškun-Ea: AO 06763 (*Rīm-Sîn* year 07), YBC 05768 (*Rīm-Sîn* year 09)

Bureau head:	*Ubār-Šamaš*?
Delivery agent:	*Sîn-māgir* (A) AO 06763 (*Rīm-Sîn* year 07)
Conveyors:	*Apil-Sîn* AO 06763 *Lāqipum* AO 06763 *Nidittum* AO 06763 *Nūr-Amurru* AO 06763 *Sîn-nagada* AO 06763 *Sîn-qāti-ṣabat* AO 06763

***al*-KA.AN**: YBC 05494 (*Rīm-Sîn* year 06), YBC 07211 (*Rīm-Sîn* year 07), Riftin 1937: no. 054 (*Rīm-Sîn* year 13$^{?}$)

Bureau head:	*Ubār-Šamaš*$^{?}$
Delivery agent:	*Sîn-māgir* SVJAD 054: 4 (*Rīm-Sîn* year 13$^{?}$)
Conveyors:	*Awīl-Ninšubur* (*ka*) Riftin 1937: no. 054 *Gimillum* YBC 05494 *Imgur-Sîn* YBC 05494 *Nidittum* Riftin 1937: no. 054 *Sîn-iddinam* YBC 05494 *Ubarrûm* YBC 05494, Riftin 1937: no. 054

al-Masabbum: YBC 07310 (*Rīm-Sîn* year 06), YBC 06985 (*Rīm-Sîn* year 07)

Bureau head:	*Ubār-Šamaš*$^{?}$
Delivery agent:	Scribe E YBC 07310 Uncertain YBC 06985
Conveyors:	*Ali-illati* YBC 06985 *Apil-Sîn* YBC 07310 *Ea-nāṣir* YBC 07310 *Imgur-Sîn* YBC 06985 *Ipqu-Ištar* YBC 07310 *Nūr-Amurru* YBC 07310 *Sîn-apil-Enlil* YBC 07310 *Sîn-qāti-ṣabat* YBC 07310, YBC 06985

Ali-illati: giri$_3$, YBC 06985: 16 (*al-Masabbum*)
Apil-Sîn: giri$_3$, YBC 07310: 11 (*al-Masabbum*); YBC 07187: 18 (not stated); YBC 06663: 12 (*al-Abī-sarē*); YBC 07194: 16 (*al-Sîn-nūr-mātim*); YBC 05580: 13 (*al-Sîn-nūr-mātim*); AO 06763: 16 (*al-Iškun-Ea*)
Awīl-Amurru: giri$_3$, YBC 05586: 12, 27 (al-MAŠ-ZI)
Awīl-Ninšubur (*ka*): giri$_3$, YBC 07194: 17 (*al-Sîn-nūr-mātim*); YBC 06231: 18 (Anzagar-Balamunamḫe); Riftin 1937: no. 054: 16 (*al*-KA.AN)
Damqum: giri$_3$, YBC 05586: 8 (al-MAŠ-ZI)
Ea-nāṣir: giri$_3$, YBC 07310: 16 (*al-Masabbum*); YBC 07187: 21 (not stated); YBC 06231: 17 (Anzagar-Balamunamḫe)
Gimillum: Recipient, YBC 05586: 6, 15, 17, 31, 44;
giri$_3$, YBC 07473: 54'; YBC 05494: 14 (*al*-KA.AN); Riftin 1937: no. 051: 12 (*al-Sîn-nūr-mātim*); Riftin 1937: no. 052: 19
Ibašši-ilum: giri$_3$, YBC 05586: 39 (*al-Idi-Uraš*)
Ilšu-bani: giri$_3$, Riftin 1937: no. 051: 14 (*al-Sîn-nūr-mātim*); YBC 06231: 16 (Anzagar-Balamunamḫe)
Imgur-Sîn; Recipient: YBC 05829: 16;
giri$_3$, YBC 05494: 16, 17 (*al*-KA.AN); YBC 06985: 14 (*al-Masabbum*); YBC 08774: 13 (not stated)
Ipqu-Ištar: giri$_3$, YBC 07310: 1 (*al-Masabbum*)

Erra-bani: $giri_3$, YBC 05586: 38 (*al-Idi-Uraš*)
Lāqipum: $giri_3$, YBC 05580: 15 (*al-Sîn-nūr-mātim*); AO 06763: 17 (*al-Iškun-Ea*); YBC 08774: 12 (not stated)
Mannum: $giri_3$, YBC 06231: 19 (Anzagar-Balamunamḫe)
Nidittum: $giri_3$, YBC 07194: 17 (*al-Sîn-nūr-mātim*); AO 06763: 18 (*al-Iškun-Ea*); Riftin 1937: no. 054: 15 (*al*-KA.AN)
Nūr-Amurru: $giri_3$, YBC 07310: 14 (*al-Masabbum*); YBC 07187: 20 (not stated); YBC 06663: 17 (*al-Abī-sarē*); YBC 06231: 20 (Anzagar-Balamunamḫe); AO 06763: 19 (*al-Iškun-Ea*)
Sîn-apil-Enlil: $giri_3$, YBC 07310: 15 (*al-Masabbum*); YBC 06663: 15 (*al-Abī-sarē*)
Sîn-errēš: Delivery agent, YBC 05586: 7 (*al*-MAŠ-ZI); YBC 08774: 2
Sîn-iddinam: $giri_3$, YBC 05494: 15 (*al*-KA.AN); YBC 06231: 15 (Anzagar-Balamunamḫe)
Sîn-māgir: Delivery agent, YBC 07195: 35 (*al-Sîn-nūr-mātim*); AO 06763: 4 (*al-Iškun-Ea*); Riftin 1937: no. 054: 4 (*al*-KA.AN); AO 07034: 4
Sîn-nagada: $giri_3$, AO 06763: 14 (*al-Iškun-Ea*)
Sîn-qāti-ṣabat: $giri_3$, YBC 07310: 12 (*al-Masabbum*); YBC 07187: 19 (not stated); YBC 06985: 15 (*al-Masabbum*); YBC 06663: 13 (*al-Abī-sarē*); YBC 05580: 14 (*al-Sîn-nūr-mātim*); AO 06763: 15 (*al-Iškun-Ea*)
Ṣillī-Šamaš: text entry: AO 06760, 57; dumu *si-mu-ug$_2$-ra*, YBC 05829: 9
Delivery agent, YBC 07194: 3 (*al-Sîn-nūr-mātim*); YBC 05580: 4 (*al-Sîn-nūr-mātim*); YBC 06231: 3 (Anzagar-Balamunamḫe);
$giri_3$, YBC 05586: 12, 27 (al-MAŠ-ZI);
Šarrūt-Sîn: $giri_3$, YBC 06231: 21 (Anzagar-Balamunamḫe)
Šērum-ilī: $giri_3$, YBC 07187: 21 (not stated)
Ubarrûm: $giri_3$, YBC 05494: 16 (*al*-KA.AN); Riftin 1937: no. 051: 13 (*al-Sîn-nūr-mātim*); lu_2 $unug^{ki}$, Riftin 1937: no. 054: 17 (*al*-KA.AN)

4.2 The Bureau of Irrigation and Excavation

There are five groups of texts that seem to relate to this bureau. The first is NBC 05474, NBC 09050 and NBC 06339 from the reign of *Sūmû-el* years 14 through 16. The second, which is only tentatively associated with this bureau, is YBC 04721 and Ashm 1922-281 dated to *Rīm-Sîn's* first year in power. The third group, NBC 11509, Riftin 1937: nos. 114-116 and MAH 15886 + 16295,[5] dates to around *Rīm-*

[5]The last text, MAH 15886 + 16295, is tentatively associated with the bureau of irrigation and excavation. As Clevenstine (2015) points out, workers in MAH 15886 + 16295 were engaged in two construction projects, a fortified place named after *Rīm-Sîn's* father, *Kudur-mabuk*, while the other project is unfortunately effaced. This unnamed project could be a canal excavation. The appearance of the name *Rīm-Sîn-rappašunu* suggests connection with this archive, as does the layout. Word choice differs, suggesting either a different author or that these individuals were active in more than one type of construction project as foremen. This would offer further evidence

Sîn's thirty-first year in power, while NBC 06763 dates to *Rīm-Sîn* year 38 and YBC 12273, the latest text, dates to *Hammu-rābi* of Babylon's thirty-eighth year in power, that is, after his conquest of the kingdom of Larsa.[6] This last text, with the same tabular format as the texts from *Rīm-Sîn*'s reign, shows that there was at least some continuity in administering the economy after *Hammu-rābi*'s conquest. Finally, another text, Ashm 1922-290, is broken and thus lacks a year date or individual names that can be attributed to anyone active in the bureau. However, based on content and text layout, it can be suggested that this text belongs to the bureau. It is tabular in format and describes irrigation and excavation projects.

The bureau is well described by Walters (1970: 144) in his monograph, where a bureau with a definite hierarchy of workers headed by what he describes as the bureau's head is portrayed. This individual, *Nur-Sîn* in the period Walters is discussing, the reign of *Sūmû-el*, is addressed as 'my lord', had troops at his command and was responsible for clearing and ordering new projects. Below the head is the inspector or developer, in his archive *Ištar-kubi*, who carries out surveys, describes new work to be done and then appraises labor needs, as well as surveying current projects (*ibid.*: 145). A 'canal contractor' was subcontracted to perform the actual canal maintenance and to carry out irrigation work in fields. These individuals guaranteed the completion of a project (*ibid.*: 148–49). Overseers working for the canal contractors led teams of workers who excavated and constructed canals (*ibid.*: 152–53). Finally, merchants were tasked when possible to oversee the operational finances (*ibid.*: 150–51) while labor contractors handled the recruitment of labor for irrigation (*ibid.*: 151). The organization of the bureau seems to have remained the same between the reigns of *Sūmû-el*, through the reign of *Rīm-Sîn*, until seven years into the reign of *Samsu-iluna*, after power was removed to Babylon[7] (Table 4.2).

Ashm 1922-290 seems to present the perspective of the bureau's head as well. This text, also lacking provenance and broken, presents what appears to be a description of a completed canal project on the obverse, which exhibits some

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of a highly integrated Old Babylonian economy, in which individuals crossed bureau or administrative boundaries in order to carry out construction projects. Tablet shape and layout for each text would suggest that tabular formatting was commonly used in planning construction projects of various types. This all must remain hypothetical. For now, the appearance of *Rīm-Sîn-rappašunu* in each text shows that he is charged both with excavations and with labor in construction, of which excavations were a part.

[6]Riftin 1937: no. 117 and BM 016391 are omitted from this list because it is difficult to ascribe a task to the labor teams in these texts—they do not state the purpose for labor, nor the purpose for redeployment of labor, nor the nature of work being carried out. BM 085211 and BM 085238 (see Sect. 8.3.4 for these texts) are also omitted from this list because they are probably student exercises and not to be mistaken for the work of a bureaucrat active in this bureau.

[7]Based on the association of BM 085211 and BM 085238 with this archive. Even if these apprenticeship texts do not properly reflect practice, they do show the continuation of this archive into *Samsu-iluna*'s reign.

Table 4.2 Bureau during the reigns of *Rīm-Sîn* and *Hammu-rābi*

Date	Author's perspective			Content
	Bureau head	Inspector	Merchants	
Rīm-Sîn year 01	YBC 04721			Grain allocated to inspectors
Date broken	Ashm 1922-290			Survey of canal projects and then entire canal
Rīm-Sîn year 01			Ashm 1922-281	Grain allocated to overseers and labor
Rīm-Sîn year 31$^{?}$		NBC 11509		Estimate of volume to be excavated by a canal contractor
Rīm-Sîn year 31		Riftin 1937: no. 114		Estimation of costs in manpower and grain allocated to canal contractors
Rīm-Sîn year 31		Riftin 1937: no. 115		Estimation of costs in manpower allocated to canal contractors
Rīm-Sîn year 31		Riftin 1937: no. 116		Estimation of costs in manpower and grain allocated to canal contractors
Rīm-Sîn year 31		MAH 15886 + 16295		Estimation of costs in manpower and grain allocated to canal contractors
Rīm-Sîn year 38		NBC 06763		Assessment of volume excavated in completed project
Hammu-rābi year 38		YBC 12273		Assessment of volume excavated and labor
Samsu-Iluna year 07		BM 085211		Estimation of volume, probably scribal practice
Samsu-Iluna year 07		BM 085238		Estimation of volume, probably scribal practice

similarities to NBC 06763, as well as a summary of the entire canal on the reverse. Perhaps this summary is similar to another summary text, published by De Graef (2002), which describes land redistributed to soldiers in Late Old Babylonian Sippar.

NBC 11509, NBC 06763 and YBC 12273 are especially interesting because they confirm this is a bureau of irrigation and excavation. As suggested in Chap. 3's introduction, NBC 11509 is predictive, an estimation of volume to be excavated based on a multiplication of length by width to produce area and area by depth to produce volume. NBC 06763, on the other hand, is suggested to state an estimation after a project's completion of total volume excavated from a canal. YBC 12273 presents descriptions of canal lengths and then labor needs in an excavation.

It serves to bridge the content of YBC 11509 and the texts associated with it, and NBC 06763. These three texts, indeed much of the archive presented here, were probably produced by various inspectors who assessed and planned new projects as well as assessing current and perhaps completed projects.

This inspector also planned costs in labor and grain and this is precisely what can be seen with YBC 12273, Riftin 1937: nos. 114-116 and MAH 15886 + 16295. In YBC 12273, the volume of each extant canal length in column 4 is associated with a work assignment in column 5, which is then used to assess labor needs for each extant excavation in column 6. Riftin 1937: no. 115 states men, both overseers and then workers in column 1 and 2, followed by the canal contractor overseeing these men in column 3. This text seeks purely to assess labor needs for an unstated project. Riftin 1937: no. 114 and 116, as well as MAH 15886 + 16295 show men, both quantities of overseers and then workmen in columns 1 and 2 respectively along with the wage rate for each individual and a total of men in column 3. This is followed by grain allocations by day and by month in column 3 and 4, and then the canal contractor who receives grain and men. These texts are predictive, estimating the amounts of grain needed for the amounts of men stated and are perhaps related to texts like Riftin 1937: no. 115. While Riftin 1937: no. 115 is ambiguous, Riftin 1937: no. 114 and 116, as well as MAH 15886 + 16295, perhaps state an evaluation and reevaluation of men and grain costs, perhaps based on a survey like that presented on YBC 12273. Riftin 1937: no. 114 is dated to the sixth month of *Rīm-Sîn*'s thirty-first year, Riftin 1937: no. 116 is dated to the ninth month of the same year, and MAH 15886 + 16295 is dated to *Rīm-Sîn's* thirty-first year as well, although the month is uncertain.[8]

Rīm-Sîn-rappašunu appears in NBC 11509, Riftin 1937: nos. 114 through 116 and MAH 15886 + 16295 discussed here, as well as in HS 2039 and CBS 07110,[9] and so he serves as an example of a canal contractor. Note that all dated texts are to *Rīm-Sîn* of Larsa's thirty-first year. This individual was probably based in Nippur, as suggested by his appearance in HS 2039 and CBS 07110. In both texts he is associated with other individuals, perhaps laborers of his, who received quantities of grain. *Rīm-Sîn-rappašunu* is stated as charged with a set of six canal sections in NBC 11509, 4 overseers and 671 men in Riftin 1937: no. 114, 20 of an unidentified variety of labor and then 218 hired hands in Riftin 1937: no. 115, 5 overseers and 667 men in Riftin 1937: no. 116, and 6 foremen and then 710 workers and overseers of 10 in MAH 15886 + 16295. He also received 2 × 60 + 16 *gur* 4 *bariga* 2 *ban* grain in Riftin 1937: no. 114, 2 × 60 + 16 *gur* 3 *bariga* 4 *ban* in Riftin 1937: no. 116, and 2 × 60 + 42 *gur* 4 *bariga* in MAH 15886 + 16295. *Rīm-Sîn-rappašunu*, in fact, was charged with the largest amounts of men and grain in each text. If *Rīm-Sîn-rappašunu* is the same individual in all these different texts, and if

[8]See Clevenstine (2015) for a discussion of the dates on this text.

[9]This identification is made by Goddeeris (2016: 264 note 4), contradicting Robertson (1992: 185) who transliterates this individual as ^{d}*ri-im*-^{d}EN.ZU-(?)*šar-šu-nu*.

all these texts deal with excavations they produce an image of a canal contractor's responsibilities in the middle of the reign of *Rīm-Sîn*: the contractor carried out excavation projects planned by the inspector using labor resources allocated by the inspector.

Ashm 1922-281 is perhaps to be attributed to a merchant overseeing day-to-day finances. The text is a list in tabular array stating first a quantity of men (column 1), then a quantity of grain (column 2) and finally a foreman (column 3) to whom these resources are allocated. Totals of men and then grain appear in line 32. The text itself is attributed here to *Nabi-Šamaš* the conveyor and perhaps a local merchant. However, the name of the individual in line 34, *Mašrum-turam*, would appear to be the official charged with the men and grain in the preceding lines and is possibly a canal contractor overseeing canal maintenance.

Thus, most of the actor categories listed by Walters (1970) in his study of irrigation works are probably active in the bureau of irrigation and excavation during the reign of *Rīm-Sîn* and then after *Hammu-rābi*'s conquest. The texts show a top-down structure where a bureau head recorded in YBC 04721 and Ashm 1922-290 oversaw the inspector who probably produced NBC 11509, Riftin 1937: nos. 114-116, MAH 15886 + 16295, NBC 06763 and YBC 12273. The inspector managed the canal contractors who in turn oversaw the day to day operations of canal excavations and maintenance as well as managed workers and grain allocations. The merchant himself, witnessed in Ashm 1922-281, oversaw costs, allocating grain or silver daily to the labor force on behalf of the contractor, inspector and ultimately the bureau head.

Text layout shifted between the early archive of *Lu-igisa* and the later archive under *Rīm-Sîn's* reign. All the authors, whether merchant or bureau head, and all the bureaucrats in between who were active during and after the reign of *R-im-Sîn* wrote in a tabular array. Moreover, numerical values, whether produced by an inspector or merchant, appear in the centesimal system described in Sect. 2.1.3, suggesting a form of professional education beyond that witnessed in the extant scribal education. Each individual had to work within a standard format and with established numbers used in this bureau, just as bureaucrats produced balanced accounts of similar shape and content in the grain storage bureau. These bureaus show traces of practice confined to each bureau and reflecting a certain amount of professional education. This synopsis is, perhaps, confirmed with BM 085211 and BM 085238, tabular texts which, as suggested in Sect. 8.3.4, are examples of scribal practice during an advanced professional education, and are not real economic texts.

Indeed, Ashm 1922-281, probably produced by a merchant, seems more like a tabular list than a formal table, and this may be due to the merchant's status in relationship to the archive. The rest of the archive used bureau officials who would have learned record-keeping practices within the archive. The merchant of Ashm 1922-281 would have only been contracted by the bureau and thus he may have been conforming to bureau practices although he was educated in a different environment.

4.3 Grain Harvest Archive

A grain harvest archive is attested in LB 1074, LB 1078 and LB 1069, employing at least two scribes and active in two different locations. A particular hierarchy is difficult to state with this bureau archive because it deals solely with the harvesting of grain. This archive may be related to the grain storage bureau, perhaps headed by the same bureau head as was active with this bureau. If so, the scribes employed in this archive would be delivery agents. One also suspects a relationship with a grain production archive similar to those described below. This is because, to plan labor needs for harvest, bureaucrats would have to be aware of field sizes and projected harvests, both of which are evaluated by the grain production archives.

Two locations are described; both are fields. The first is the field of *Agakkum* in LB 1074 attributed to scribe L. The second is the field of *Hazazanum* in LB 1078 attributed to this same scribe L and LB 1069, attributed to scribe M. The archive is active during two periods over the same year. The first two texts, attributed to scribe L appear at the end of the first and beginning of the second months of *Rīm-Sîn's* thirty-eighth year while the third text, LB 1069, appears at the end of the thirteenth month, an intercalary month, of the same year. This would place LB 1069 around the same season as LB 1074. Thus, all three texts revolve around the same season and activities, although scribe M replaced scribe L in this archive. In addition, when visible in the texts, wage rates fluctuate per year. Binders in LB 1074 are paid at a rate of 2 *ban* per man(-day) while in LB 1069, although this is not directly stated, binders are paid at 1 *ban* 5 *sila* per man(-day). However, gatherers in each text are paid at the same rate of 1 *ban* per man(-day).

4.4 Grain Production Archive(s)

A second bureau archive—or perhaps two—appears under the reign of *Hammu-rābi*, after his conquest of the kingdom of Larsa.[10] Here three texts are examined, attributed to two scribes. The first text, Ashm 1923-311 attributed to scribe O active in *Hammu-rābi*'s thirty-second year in power, is in prosaic format and predicts grain yields expected from agricultural production. Distinction is made between unqualified fields (a-ša$_3$) and long fields (a-ša$_3$-gid$_2$). Oxen are also allocated for the purpose of exploiting these fields. In this text, the scribe makes clear in lines 34' through 37' that production has not yet begun so that these are indeed predictions in

[10]See Fiette (2018) where this archive is discussed. At the time the manuscript for this work was submitted, Fiette's brilliant synopsis had not appeared so that his results could not be integrated into this study. While I stand by the results of the my discussion and especially my numeric studies of Ashm 1922-277 and Ashm 1923-340, Fiette's work presents a full image of the bureau for which these texts belong, a picture of the activities of this bureau's main actors and new interpretations of these texts. Moreover, his reconstruction offers the potential for a greater study of numeracy within this bureau.

preparation of planting. Mention of the palace in broken line 33' suggests that the land being worked is state controlled. A location is stated in line 38', the bank of the *uggimdu* on the other side of the place *Šamaš-ea*. The exact location, however, is uncertain.

With the second scribe, scribe P, there is a significant shift which suggests either an administrative change, a completely separate archive or a different audience for the texts. Three years separate scribe P operating in *Hammu-rābi*'s thirty-fifth year and scribe O operating in *Hammu-rābi*'s thirty-second year. Scribe P is working for the temple of Nanna as stated in lines 2 of both Ashm 1922-277 and Ashm 1923-340 and so his activity is probably around Ur, even if he could well be an agent from Larsa itself. Both Ashm 1922-277, dated to month three, day twenty, and Ashm 1923-340, dated to month three, day twenty-two, exhibit expected yields from a series of fields.

It is hypothesized here that these two scribes were field inspectors, similar to the canal inspectors of the bureau of irrigation and excavation. They may have acted together with or as delivery agents with a grain storage bureau during harvest, if there were connections between the grain production archive and a grain harvest archive and if a grain storage bureau still existed during the reign of *Hammu-rābi*. Because all three texts present an amount of surveyed land and then the projected yield, it can be said that the field inspector both surveyed land as well as projected yields in advance of planting. Scribe T, the author of LB 1097, is also suggested to be a field inspector, perhaps active around the city of Umma, although it is not clear when. This author projects costs in field production. He is thus employed in planning agricultural activity as well, and his assessment is clearly a temporary one, as shown by the lack of any date formula.

4.5 Conclusions

This chapter has asked 'what do the texts studied here tell us about the environments in which they were produced'? in order to outline tacit knowledge about administrative structures that may have affected each scribe's mathematical reasoning. We can now give some answers to this question. To start with, many of the scribes worked at least part of the time in some kind of bureaucratic environment. This is evident in the case of the grain storage bureau, the bureau of irrigation and excavation, the grain harvest archive and the grain production archive. A distinction was thus made immediately between bureau archives on the one hand, and larger bureaus on the other, which were made up of several bureau archives.

With the grain storage bureau multiple individuals with a variety of professions were active at various administrative levels. However, these scribes, by and large, seemed to conform to standard record-keeping practices, a form of double entry record keeping as described in Chap. 3 which underlines an important point: conformity of practice is enforced by each bureau or archive. Thus, the bureau of irrigation and excavation exhibited a shift from a prosaic format with the *Lu-igisa*

archive dated to the reign of *Sūmû-el* to a tabular format by the reign of *Rīm-Sîn*. This later incarnation of the bureau also counted men using the centesimal system for counting discrete objects. This was the case for officials within the archive, such as the canal inspector attested by Riftin 1937: no. 114, Riftin 1937: no. 115 and Riftin 1937: no. 116, who was an active bureaucrat within this archive in the middle of *Rīm-Sîn's* reign, as well as the merchant contractor of Ashm 1922-281 who was only hired for work in this archive at the beginning of *Rīm-Sîn's* reign.

These standard practices are reinforced in Appendix 2, where scribes exhibited specialized knowledge that may have been the result of a professional education. Standard practice shows limited practical knowledge localized to an individual bureau or archive. This localized knowledge, as well as specialized knowledge exhibited by each scribe, suggests microcultural variety in mathematical practice, a variety that will be repeatedly discussed throughout this volume.

Chapter 5
Metrology and Sexagesimal Place Value Notation in Economic Texts

Abstract This chapter explores the numerical basis of calculation in the economic texts. Discussion is divided into three parts. First, the transparency of economic texts is explored, looking at whether the economic texts present all data used to produce a quantity or whether tacit knowledge went into a text's production. Next, measurement values within the texts are examined to see whether these values were transformed into sexagesimal place value notation (SPVN) or not. Did SPVN need to be specifically stated to demonstrate its use in a text? Finally, explicit examples of place value notations in the economic texts are examined to explore whether these are SPVN or something different. It is shown that as a rule scribes only stated information they deemed important in texts so that calculation and the basis for this calculation were not always necessary to a text's construction. While SPVN was probably not used to produce every economic text, there does seem to be a general tendency toward multiplication using SPVN. The metrological lists and tables, as well as the numerical tables, produced building blocks to calculate with sexagesimal place value notation. These building blocks served as a basis for standardization when estimating value. This chapter is supplemented by Appendix 4 where equivalency and labor rates are examined.

Chapter 2 showed that the metrological tables in which measurement values were associated with numerical values in SPVN, and then numerical tables which provided the building blocks for calculating with SPVN, were both learned in an elementary phase of the scribal education. While it differed superficially from center to center, and even within a center, the metrological and numerical system remained the same. In every case, SPVN played an important role in education. This means that the accounting systems that existed in the kingdom of Larsa at this time, as they were described in Chap. 3, probably relied extensively on the basic elementary education as it existed in each scribal center, whether this education occurred in a classroom setting or in a professional setting.

R. Middeke-Conlin, *The Making of a Scribe*, Why the Sciences of the Ancient World Matter 4, https://doi.org/10.1007/978-3-030-35951-5_5

As Chap. 2 showed, calculating with SPVN took three parts: transformation from measurement values to SPVN, calculation with SPVN and then transformation back from SPVN to measurement values.[1] SPVN only appeared during calculation, while, as pointed out in Chap. 3, economic texts would only state already obtained numeric data—the results of one calculation that could then be used in another calculation. The appearance of SPVN in a text clearly representing calculation is not expected and would be, under this synopsis, anomalous. Was this system used to produce metrological and numerical data found on economic texts? Can the numerical basis for calculation in the texts themselves be detected?

These are important questions underlying this work. Studying the various metrological lists and tables only explains that *a* system of quantification existed. It does not prove the utility of this system of quantification. It does not, in and of itself, determine how this system fit within the culture that produced it. Nor is it certain whether this system would be detectable in the texts themselves. If the numerical basis for calculation cannot be detected and explained, then how and why rounding occurred cannot be explained, discrepancies cannot be accounted for and the mathematical practice utilized by each scribe cannot be determined.

Rounding numbers is hypothesized to be useful as a tool for detecting how the systems of quantification were understood and manipulated by the scribes themselves. Thus, while the numerical and metrological systems are presented in the mathematical texts, it is proposed that the economic texts will display how the scribes themselves understood and manipulated these systems. Further, it is hypothesized that approximations, especially rounded values and numbers, can show exactly what was presented in these educational environments. Were the numerical and metrological systems necessarily learned by each scribe? Or were only parts of these systems learned by scribes? To even begin to answer this, the numerical basis of calculation within the texts themselves must be detectable. This chapter begins to explore the basis of calculation, whether based on measurement value, SPVN or both measurement value and SPVN.

Discussion is divided into three parts. First, the transparency of economic texts is explored to ascertain whether the economic texts present all data used to produce a quantity or whether tacit knowledge informed the production of a text. Next, consistency between texts is examined to see whether measurement values were transformed into SPVN or not. Did SPVN need to be specifically stated to demonstrate its use in a text? Finally, explicit examples of place value notations in the texts are examined to ascertain whether these are SPVN or something different. Does SPVN appear in the economic texts? Each form of evidence, when taken separately, is inconclusive. When taken as a whole, however, will the use of SPVN become apparent as the basis for some calculations? What environments could SPVN be used in? Was this the result of the scribal curriculum?

[1]Summarized by Proust (2007: 249–251 and Table 20).

5.1 The Transparency of Economic Texts

To begin with, not all texts are transparent. Several examples decisively confirm this. YBC 06216, dated to *Rīm-Sîn* of Larsa's ninth regnal year and possibly from the grain storage bureau, is especially difficult to explain. It seems to be a list of grain disbursements, mostly to named persons, for household use. The total in line 12 adds 2 *gur* grain to what is listed in the document, resulting in a difference of 3.85 per cent.[2] While 52 *gur* is the expected total, 54 *gur* is stated. Collation reveals no discrepancy between copy and text. Three possibilities for this discrepancy can be suggested. First, there could be a mistake: Did the author omit an entry or numerical value(s) adding up to 2 *gur*? Or did he mistakenly write 4 *gur* in the total?

Another possibility is a two-part additive process. In the text there are two types of entries: line one is a total grain deduction while the remaining ten lines state individual entries. It is possible that lines 2 through 11 were added together, producing 38 *gur*, which was rounded up to 40 *gur* and then added to the deduction in line 1. This would have yielded the stated 54 *gur* total in line 12.

The third possibility would be that 52 *gur*, the expected total, transformed to 4:20, a non-regular number, while 54 *gur*, the stated total, transformed to 4:30, a regular number. It must be recalled that in calculating with SPVN, an actor would multiply by a number's reciprocal in place of division. As will be seen in Sect. 8.2.3 and the introduction of Chap. 9, non-regular numbers were numbers that, as far as the Old Babylonians were concerned, did not have a finite reciprocal for which to carry out such a multiplication, and therefore some approximation was required to calculate with them. Perhaps the scribe rounded the total up based on SPVN rather than metrology, which would mean that the scribe expected to use the total in a calculation with SPVN later. In any event, in this suggestion he rounded up SPVN 4:20 to 4:30 (Table 5.1).

Even when there is no discrepancy between expected and actual quantities, the amounts and numbers used present difficulty in interpreting calculations. AUAM 73.2672, a merchant account dated to *Samsu-Iluna* of Babylon's seventh regnal year, is representative of this. The rate used in AUAM 73.2672, 2 *gur* per *gin* silver, is not transparent. It looks on the surface like a simple division by two or just cutting the number in half: one-half of 18 *gur* is 9 so that 9 *gin* silver for 18 *gur* dates is expected. However, if transformed to SPVN, multiplication is just as simple because the in-kind rate, 10, the reciprocal of 6, yielded a simple multiplication as well, as Table 5.2 shows.

In Table 5.2, 18 *gur*, the in-kind value stated in the text transforms to 1:30 in SPVN. The metrological table on which transformation is based follows each transformation. 2 *gur*, the in-kind rate stated in the text, transforms to 10 in SPVN based on the metrological table of capacity. To find the in-silver value, find the

[2]Per cent differences are used here and throughout this book to show the modern reader the relative size of a discrepancy, not to make any statement about the author's awareness of a concept of percentage or per cent [see above] difference.

Table 5.1 Calculation for YBC 06216, expected total and actual total

Line	Notes	Quantity	
1		14 *gur*	
2		8 *gur*	
3		8 *gur*	
4		8 *gur*	
5		1 *gur*	
6		1 *gur*	
7		2 *gur*	
8		2 *gur*	
9		3 *gur*	
10		3 *gur*	
11		2 *gur*	
12	Extant total	54 *gur*	*4:30*
	Expected total	**52 gur**	*4:20*

Table 5.2 Possible equivalency calculation for AUAM 73.2672

1	1(u) 8(aš) gur zu_2-lum	18 *gur* dates
2	kar-bi 2(aš) gur-ta-am_3	Its rate 2 *gur* per (*gin*)
3	ku_3-bi 9(diš) gin_2	Its silver 9 *gin*

In-kind value
18 *gur* → *1:30* (table of capacity)
In-kind rate
2 *gur* → *10* (table of capacity)
The reciprocal of *10* is *6*
6 × *1:30* = *9*
In-silver value
9 → 9 *gin* (table of weight)

reciprocal of 10, that is 6, and multiply the in-kind value, 1:30, by 6, the reciprocal of 10, to produce 9. 9 is the SPVN transformation of 9 *gin* so that for this calculation, 9 *gin* silver is the equivalent of 18 *gur* dates. Rates like this are called equivalency rates, that is, where one good, which is presented in one system, is assessed by means of another good, usually silver or grain, at a stated rate. Equivalencies and equivalency rates will be described in more detail in Sect. 8.2. A scribe who was well practiced in the metrological and numerical tables introduced in the elementary education would have found both transformation and calculation very simple in this example, so that the use of SPVN in this calculation cannot be ruled out.

For the current discussion, as Appendix 4 shows, a rate of 10, the reciprocal of 6, is very common in the Old Babylonian period (see also Sect. 5.2 below). Thus, it is

Table 5.3 Four texts with unstated but implied totals

I. Text	II. Subject	III. Archive	IV. Scribe	V. Year	VI. Location
LB 1074	Agricultural activity, field of *Agakkum*	Grain harvest archive	Scribe L	*Rīm-Sîn* year 38	Uncertain
LB 1078	Agricultural activity, field of *Hazazanum*	Grain harvest archive	Scribe L	*Rīm-Sîn* year 38	Uncertain
YBC 07744	Deliveries of fish evaluated in silver	Merchant intermediaries	*Sîn-muštāl*	*Hammu-rābi* year 41	Ur or Larsa
YBC 07787	*sūtu* text, fish	Merchant intermediaries	*Iddin-Ištar*	*Hammu-rābi* year 43	Larsa

difficult to say whether the equivalency was made using measurement values alone or transformation to and from SPVN.

Calculations in texts are not always transparent. Information is not always stated. Some texts, however, do show the information necessary to understand what quantities were used in a total, even if the total itself is not stated. LB 1074 and LB 1078, dated to *Rīm-Sîn* of Larsa's thirty-ninth year, both exhibit this. YBC 07744 and YBC 07787, dated to *Hammu-rābi* of Babylon's forty-first and forty-third years respectively, exhibit this to a certain extent as well (Table 5.3).

Both LB 1074 and LB 1078 describe grain expenditures in harvesting of fields and belong to the grain harvest archive. The calculation in lines one through eight of LB 1074 and one through four of LB 1078 are interesting. While the amount of grain expended is the goal of each text, these lines state only quantities of men and rates of grain per man per day as well as a total grain allocation at the end of each section. Thus, in LB 1074 there are four quantities of men and four rates with only one total grain. These two texts contain a two-part calculation. First, total grain per type of labor is calculated out of a wage rate and total men. These totals are then added together to produce a total in grain expressed in line 8. There is a discrepancy in LB 1074 between the expected and extant total. As will be shown in Chap. 6, this discrepancy is probably a mistake in addition, not multiplication.

In Table 5.4 and all subsequent charts and figures, underlined entries denote values that are not found in the text but are the results of modern calculations and then restorations based on information found in the texts. Here it is important to note that, while the quantities used in calculation can be restored, these are not stated in the text and thus a discrepancy is not easily recognized in the text, so that transparency is limited.

YBC 07744 lists a series of transactions in which fish, described either in weight or capacity are assessed by a silver value and then provided to a merchant, *Watar-Šamaš* the overseer of 5, by another merchant, *Sîn-muštāl* the merchant overseer at Ur. This text probably represents part of the same system of merchant intermediaries as described in Chaps. 2 and 3. The transactions in lines 1 through 3 and 4 through 6 present two rates per transaction. Fish are originally assessed in weight and then the corresponding number of fish is found, which should be represented in system S, by means of a stated rate. In lines 1 through 3, a weight of 35 *gu* of fish is equivalent to the unstated quantity $1 \times 60^2 + 40 \times 60 + 5 \times 60$ fish at the rate of 3 sixties fish per *gu* fish weight. The unstated quantity of fish is then evaluated by

Table 5.4 Comparison of calculations between LB 1074 and LB 1078

Calculation LB 1074 lines 1–8				
Line	Notes	Grain		
1	43 men, 2 *ban* each	*2 gur*	*4 bariga*	*2 ban*
3	32 men, 1 *ban* each	*1 gur*		*2 ban*
5	5 men, 1 *ban* each			*5 ban*
6	2 men, 1 *ban* each			*2 ban*
8	Extant subtotal	4 *gur*	1 *bariga*	5 *ban*
	Expected subtotal	4 *gur*		5 *ban*

Calculation LB 1078 lines 1–11				
Notes	Grain			Men
6 men, 1 *ban* 2 *sila* each	*1 bariga*	*3 ban*	*6 sila*	8
12 men, 4 *sila* each		*4 ban*	*8 sila*	12
Subtotal	2 *bariga*	2 *ban*	4 *sila*	20
		1 *ban*	2 *sila*	1
9 men, 1 *ban* 2 *sila* each	*1 bariga*	*4 ban*	*8 sila*	9
12 men, 4 *sila* each		*4 ban*	*8 sila*	12
Subtotal	2 *bariga*	3 *ban*	6 *sila*	

the rate 4 sixties fish per *gin* silver to produce the stated silver equivalent 1/3 *mana* 6 *gin* one-4th weight (for more on this, see Sect. 8.2). For now, it is important to highlight that only weight is stated and not the quantity of fish, which should be represented in system S, even if value in silver is established from the quantities in system S.

Finally, in YBC 07787 a quantity of fish and dates is implied and assessed in silver, but no equivalency rate is stated so that it is impossible to estimate exactly how many fish and dates are provided. The goal of this text is solely to find the value of fish and dates in silver, so that the values in quantity of fish and dates was deemed unimportant.

It becomes clear that not all texts explicitly state how they were produced. As evident in YBC 06216, discrepancies between a stated and expected value are not explained. Numbers that went into a values' production are not stated, as is shown with AUAM 73.2672. Finally, not all values that went into the total found on a text, nor all values that were used to construct a text, are stated as is shown with LB 1074, LB 1078, YBC 07744 and YBC 07787. However, as is seen in LB 1074, LB 1078 and YBC 07744, some scribes do leave us with enough information to reproduce this data in order to maintain some transparency. These texts will be discussed in more detail in Chap. 8.

5.2 Possible Sexagesimal Place Value Notation Basis for Calculations

Texts are not always transparent to the modern observer in terms of how totals are reached, let alone the numerical system that went into producing the texts themselves. However, traces of an underlying system can be seen in many texts. Equivalency rates, which will be discussed more in Chap. 8, were mentioned while discussing several texts above, such as texts YBC 07744 and AUAM 73.2672. With AUAM 73.2672 it was unclear from the text alone whether calculation was based on measurement value or SPVN. Also, wage rates, which will be explored in depth in Chap. 8, were mentioned in conjunction with LB 1074 and LB 1078. For now, the question is 'can underlying SPVN numbers used to calculate with these rates be suggested'? 'was calculation based on measurement values or the SPVN transformations of these values'?

In pursuit of this, Appendix 4 was compiled. Appendix 4 lists equivalency and wage rates from the Old Babylonian kingdom of Larsa that were used to assess the value of commodities and labor. In Appendix 4.A through 4.C, sources are presented for equivalencies using silver as a medium (4.A), grain as a medium (4.B) and then for wages in grain (4.C). In 4.D there are six charts used to sum up these equivalencies and rates. Four charts represent price or silver and grain equivalency rates as they are stated in the text, while two present labor in the form of wages. Charts 1 and 2 present all silver and grain rates as stated or suggested by the texts while Charts 3 and 4 represent only rates that are expressly stated in the text themselves.

Charts 2, 4 and 6 state the distribution of equivalency and wage rates when transformed to SPVN. While there are numerous examples of a value appearing only once after transformation into SPVN, there is a tendency towards certain rates after transformation to SPVN. In particular, the following SPVN rate relationships appear often in the texts: 1 to 1, the reciprocal of 2 is 30, the reciprocal of 3 is 20, the reciprocal of 4 is 15, the reciprocal of 6 is 10, the reciprocal of 10 is 6, the reciprocal of 12 is 5, the reciprocal of 15 is 4 and the reciprocal of 20 is 3. Focus here will be on the reciprocal of 6 is 10 and the reciprocal of 12 is 5.

Concerning equivalencies, the pair 6 and 10 appears nine times in seven texts while its reverse appears eight times in seven texts, in and between multiple metrological systems: it represented an equivalency between capacity and weight; 6 and 10 appears as 1 *gur* 1 *bariga* per *gin* silver (LB 1092). It also represented an equivalency between capacity and a counted item when it appears as 1 *ban* per unit of *karalum*-reeds (YBC 04828). The pair 6 and 10 represents an equivalency between weight and a counted item with one-6th *gin* per ewe (YBC 04797), and then 10 *gin* per unit bracelets (YBC 07473: 47', AO 06760) and beer jar (which is further valued as 2 *ban* beer per jar; AO 07035: 6). Finally, it is an equivalency between two weights, 10 *gin* (silver) per *gin* (gold, NBC 08014: 1–3) and 6 *mana* (copper, bronze) per *gin* silver (AO 06760: 13–14 and 36–37 respectively). The reciprocal of 10 is 6 appears variously as 2 *gur* per *gin* silver, 10 $\times$ 60 fish per *gin*

Table 5.5 The Old Babylonian reciprocal table

1(diš)-da 2/3-bi	4(u)-am$_3$	From 1 its 2/3 is 40
šu-ra-bi	3(u)-am$_3$	Its half is 30
igi 2(diš)-gal$_2$-bi	3(u)-am$_3$	The reciprocal of 2 is 30
igi 3(diš)-gal$_2$-bi	2(u)	The reciprocal of 3 is 20
igi 4(diš)-gal$_2$-bi	1(u) (u)5(diš)	The reciprocal of 4 is 15
igi 5(diš)-gal$_2$-bi	1(u) 2(diš)	The reciprocal of 5 is 12
igi 6(diš)-gal$_2$-bi	1(u)	The reciprocal of 6 is 10
igi 8(diš)-gal$_2$-bi	7(diš) 3(u)	The reciprocal of 8 is 7:30
igi 9(diš)-gal$_2$-bi	6(diš) 4(u)	The reciprocal of 9 is 6:40
igi 1(u)-gal$_2$-bi	6(diš)	The reciprocal of 10 is 6
igi 1(u) 2(diš)-gal$_2$-bi	5(diš)	The reciprocal of 12 is 5
igi 1(u) 5(diš)-gal$_2$-bi	4(diš)	The reciprocal of 15 is 4
igi 1(u) 6(diš)-gal$_2$-bi	3(diš) 4(u) 5(diš)	The reciprocal of 16 is 3:45
igi 1(u) 8(diš)-gal$_2$-bi	3(diš) 2(u)	The reciprocal of 18 is 3:20
igi 2(u)-gal$_2$-bi	3(diš)	The reciprocal of 20 is 3
igi 2(u) 4(diš)-gal$_2$-bi	2(diš) 3(u)	The reciprocal of 24 is 2:30
igi 2(u) 5(diš)-gal$_2$-bi	2(diš) 2(u) 4(diš)	The reciprocal of 25 is 2:24
igi 2(u) 7(diš)-gal$_2$-bi	2(diš) 1(u) 3(diš) 2(u)	The reciprocal of 27 is 2:13:20
igi 3(u)-gal$_2$-bi	2(diš)	The reciprocal of 20 is 2
igi 3(u) 2(diš)-gal$_2$-bi	1(diš) 5(u) 2(diš)3(u)	The reciprocal of 32 is 1:54:30
igi 3(u) 6(diš)-gal$_2$-bi	1(diš) 4(u)	The reciprocal of 36 is 1:40
igi 4(u)-gal$_2$-bi	1(diš) 3(u)	The reciprocal of 40 is 1:30
igi 4(u) 5(diš)-gal$_2$-bi	1(diš) 2(u)	The reciprocal of 45 is 1:20
igi 4(u) 8(diš)-gal$_2$-bi	1(diš) 1(u)5(diš)	The reciprocal of 48 is 1:15
igi 5(u)-gal$_2$-bi	1(diš) 1(u)2(diš)	The reciprocal of 50 is 1:12
igi 5(u) 4(diš)-gal$_2$-bi	1(diš) 6(diš) 4(u)	The reciprocal of 54 is 1:6:40
igi 1(diš)-gal$_2$-bi	1(diš)	The reciprocal of 1 is 1
igi 1(diš) 4(diš)-gal$_2$-bi	5(u) 6(diš) 1(u) 5(diš)	The reciprocal of 1:4 is 56:15
igi 1(diš) 2(u) 1(diš)-gal$_2$-bi	4(u) 4(diš) 2(u) 6(diš) 4(u)	The reciprocal of 1:21 is 44:26:40

fish, 10 *mana* per unit, 10 *mana* per *gin* silver, and 10 *gin* tin per *gin* silver. When wage rates are examined, even more examples of the reciprocal of 6 is 10 and its reverse appear. Thus, there are four examples in two texts of the reciprocal of 6 is 10 while there are five examples in one text of the reciprocal of 10 is 6.

This is not limited to 6 and 10. Concerning equivalency rates again, there are fourteen examples in eight texts of the reciprocal pair 12 and 5, while its reverse, the reciprocal pair 5 and 12, occurs twice in two texts. The reciprocal pair 12 and 5 appears variously with 12 *gu* per *gin* silver, 12 *mana* per *gin* silver, 5 *gin* silver per *gin* gold, 5 *gin* silver per unit and 15 *še* per unit, while the pair 5 and 12 appears as 5 *gin* oil per *gin* silver and 1 *gur* fish per *gin* silver. With labor there are 15

Table 5.6 Mentioned equivalency rate accounts

I. Text	II. Subject	III. Archive	IV. Scribe	V. Year	VI. Location
NBC 08014	Sales contract of gold assessed in silver	Merchant	*Ilšu-ibbišu*	*Sîn-iddinam* year 06	Perhaps Larsa
LB 1092	Various silver expenditures	Household	Scribe C	Reign of *Rīm-Sîn*?	Uncertain
YBC 07473	Disbursement of goods evaluated in silver	Merchant intermediaries	*Itti-Sîn-milki*	*Rīm-Sîn* year 04	*Zarbilum*
AO 06760	Disbursement of goods evaluated in silver	Merchant intermediaries	*Ubār-Šamaš*	*Rīm-Sîn* year 02	Larsa
AO 07035	Evaluation of temple goods, labor in silver	Merchant intermediaries	Uncertain	*Rīm-Sîn* year 16	Uncertain, Ur or Larsa
YBC 04828	List of reeds and grain equivalents	Household	*Aḫatu*-xx	–	Uncertain
YBC 04797	Disbursement of goods evaluated in silver	Merchant intermediaries?	*Ilī-ṣulūlī*?	*Rīm-Sîn* year 32	Uncertain

examples in two texts of the reciprocal of 5 is 12. Both '12 and 5' and '5 and 12', as well as with '6 and 10' and '10 and 6' are used to produce equivalencies and labor calculations within one measurement system as well as between measurement systems when measurement values are transformed to SPVN. See Table 5.6 for equivalency rates found in the texts discussed here.

There appears to be a sort of conformity in the economic texts based on a few reciprocal pairs. Conformity is understood here as use of established rates or numbers set by social custom or economic conventions. However, conformity can be used to describe any established (mathematical) practice set by social custom or economic conventions. The use of reciprocal pairs here may be a means to create this conformity. These reciprocal pairs are each found on the standard reciprocal tables as witnessed at Nippur (see above, Table 5.5 as well as Sect. 2.2.3 for this list). There is also evidence for a similar list at Ur, although with Ur this is only visible in a few calculations found on type IV exercise tablets. These pairs include the reciprocals 5 and 12, 6 and 10, 10 and 6, and 12 and 5. The same can be suggested for the pairs 2 and 30, 3 and 20, 4 and 15, 15 and 4, 20 and 3, as well as 30 and 2; all of these reciprocal pairs appear on the standard reciprocal table and were probably learned throughout Southern Mesopotamia. These numbers also appear on multiplication tables throughout Southern Mesopotamia, such as the table of 5 seen at Nippur and suggested at Ur, the table of 6 at Nippur alone, the table of 12 at Nippur and Larsa and the table of 10 seen or suggested at all three scribal centers evaluated in Chap. 2. Moreover, it is also safe to say that multiplication tables for 2, 3, 4, 15, 20 and 30 were all probably learned in the elementary scribal education as present in each of the scribal centers surveyed in Chap. 2.[3]

[3]See Appendix 3 for a list of numerical tables and their provenance.

Van de Mieroop (2004) points to the possible importance of conformity, as defined above, as a means to estimate labor. Established and typical rates were applied to work to be carried out regardless of the conditions of work: 'The accountant viewed the world on the basis of standard rates, which may have been originally based on observation, but became mathematical formulae detached from reality' (*ibid*.: 57). The quantity of work to be done and costs could be evaluated systematically using established or customary rates. This created conformity which could be reflected in a few SPVN reciprocal pairs underlying diverse measurement values. On the other hand, the wage rates presented here are inconclusive because there is, simply, little diversity in the rates (a product of conformity). Thus, with 1 *ban* 2 *sila*, the wage rate in LB 1078 lines 6–7 and YBC 05418, lines 8 through 18, conformity could also simply be in the measurement values (see Table 5.7 for these texts). However, conformity probably occurred with equivalencies and, as shown above, this conformity is seemingly based on SPVN, not measurement value.

Why would scribes calculate equivalencies using SPVN rather than measurement values alone? Four out of seven scribes are acting as merchant intermediaries, one as a simple merchant and two others function as household administrators. The merchant intermediaries might be using established rates as assessed by either the *kārum*, that is to say the local merchant community, or the palace. They are acting in a pseudo-official environment in which established rates could be a means to help assess the value of palace property. The same can be suggested for the merchant, *Ilšu-ibbišu*, who is acting in some official environment, as implied by the appearance of *šatammu* officials in the witness list of this contract. The stated price is possibly an official price of gold established by the community of witnesses mentioned in this contract. The two persons acting on a household level could easily be evaluating their own activity, one in grain and one in silver, and using rates conformed by custom or set in the local *kārum* as a tool to help assess value. YBC 04828 is probably a temporary list because there is no year date, only the month and day.

In each environment, whether merchant or household, certain values and numbers would be chosen out of a desire to simplify calculation and improve transparency. As shown in Chap. 2, the elementary scribal curriculum produced basic building blocks, both to transform measurement values to and from SPVN and to calculate with SPVN. While there were microcultural variations in the presentation of this system in each scribal curriculum, the system itself did not change between

Table 5.7 Texts that mention wage rates

I. Text	II. Subject	III. Archive	IV. Scribe	V. Year	VI. Location
LB 1078	Agricultural activity, field of *Hazazanum*	Grain harvest archive	Scribe L	*Rīm-Sîn* year 38	Uncertain
YBC 05418	Rations, various (temple) officials	Bureau-temple	Uncertain	*Warad-Sîn* year 10	Perhaps Ur

centers and would have been memorized throughout the kingdom of Larsa. Calculating with these building blocks would have been very simple for each scribe, while values based on these building blocks would have been easily recognizable from one center to another and within each center. Conformity based on SPVN would have been simple and transparent to the actors who partook in the basic elementary education as it existed throughout the kingdom of Larsa, with minor variations.

Examining two seemingly similar texts produced in similar environments may help to illustrate the value of rate conformity as described above: AO 08464 and AO 08463. Both are attributed to merchants and were produced within four years of each other. AO 08464 is dated to *Rīm-Sîn* year twenty-seven, while AO 08463 is written in *Rīm-Sîn*'s thirty-first year. Both offer silver values for goods in-kind. However, while AO 08464 states equivalency rates, AO 08463 does not. It simply states the value, not the rate in silver per good. Prices for each are seen in Table 5.8.

In Table 5.8, the total in-kind value of each good is stated in column II, the total in-silver value of this good is stated in column III, the rate or expected rate of evaluation is stated in column IV, while the SPVN transformation of this rate is stated in-kind in column V and in-silver in column VI. When an entry is underlined, this means the entry is not stated in the original text but is a modern reconstruction. NR stands for no reciprocal. This happens because the SPVN transformations of in-kind and in-silver rates are reciprocal pairs so that, if one number is a non-regular number, then its reciprocal could not be used in computation. Non-regular numbers will be discussed more in Sect. 8.2.3 and Chap. 9.

The rates in AO 08464 produce only reciprocal pairs that are found on the reciprocal table and that have a corresponding table of multiplication. Moreover, AO 08464 exhibits a tendency toward particular reciprocal pairs: the reciprocal pair 3 and 20 appears five times. The reciprocal pair 2 and 30 appears twice. 15 and 4 appears twice, as does 5 and 12. Finally, the pairs 18 and 3:20, 1:30 and 40, as well as a 1 to 1 relationship appear once each (Table 5.9).

In addition, the reciprocal pair 12 and 5 is used to qualify lines 11 through 15, that is, to evaluate four varieties of wood with measurement values of 10 *mana* each so that this reciprocal pair might refer to five equivalency rates, not two. AO 08464 mostly states rates by weight. However, the reciprocal of 3 is 20 is seen corresponding to two metrological systems. In lines 22 to 23, 28 and 29 to 30, it corresponds to a rate where 1/3 *gin* weight is the silver equivalent of a variety of livestock. In line 10, 3 *sila* oil, measured in capacity, is worth 1 *gin* silver. The same phenomenon happens with 12 and 5. Wood evaluated at 12 *mana* wood per *gin* silver, and premium oil evaluated at 5 *gin* silver per *gin* oil both revolve around the reciprocal pair 12 and 5.

With AO 08463 prices are very different. Often there is no reciprocal pair according to the Old Babylonian SPVN numerical system presented in Chap. 2. This phenomenon is witnessed in eight out of ten entries. In addition, most of the SPVN numbers that could have been used to evaluate these items would have required at least two multiplication tables to evaluate the in-kind item in silver.

Table 5.8 Comparison of rate between AO 08464 and AO 08463

AO 08464

I. Lines	II. In-kind value	III. In-silver value	IV. Stated rate	V. In-kind rate SPVN	VI. In-silver rate SPVN
2–3	8 *gin* gold	1/2 *mana* 2 *gin*	4 *gin* (silver per *gin* gold)	15	*4*
4–5	5 *gin* gold	15 *gin*	3 *gin* (silver per *gin* gold)	20	***3***
6–7	4 *gur* 1 *ban* oil	1 *mana* 7 one-6th *gin* 10 *še*	1 *ban* 8 (sila oil per gin silver)	*18*	3:20
8–9	1 *bariga* 1 *sila* premium oil	12 one-6th *gin* 6 *še*	5 *gin* (silver per *gin* oil)	*5*	12
10	1 *ban* perfumed oil	3 1/3 *gin*	3 *sila* (per *gin*)	*3*	20
11–15	40 *mana* (10 each of cedar, juniper, cypress, white cedar)	3 1/3 *gin*	12 *mana* (wood per *gin* silver)	*12*	5
16–17	4 *ban* 2 *sila* mixed perfumes	2/3 *gin* 6 *še*	1 *bariga* (perfume per *gin* silver)	*1*	1
18–19	40 rams	1/3 *mana* 6 2/3 *gin*	2/3 *gin* (silver per ram)	1:30	*40*
20–21	1 × 60 + 7 rams	1/2 *mana* 3 1/2 *gin*	1/2 *gin* (silver per ram)	2	*30*
22–23	9 rams without fleece	3 *gin*	1/3 *gin* (silver per ram)	3	*20*
24–25	1 × 60 + 39 ewes	2/3 *mana* 9 1/2 *gin*	1/2 *gin* (silver per ewe)	2	*30*
26–27	10 ewes without fleece	2 1/2 *gin*	One-4th (*gin* silver per ewe)	4	*15*
28	16 lambs	5 1/3 *gin*	1/3 *gin* (silver per lamb)	3	*20*
29–30	34 female x-goats	11 1/3 *gin*	1/3 *gin* (silver per goat)	3	*20*

AO 08463

I. Lines	II. In-kind value	III. In-silver value	IV. Unstated rate	V. In-kind rate SPVN	VI. In-silver rate SPVN
3	1 *gin* 18 *še* gold	5 *gin*	One-6th gin 9 1/2 še 2 gold per gin silver	13:12	NR
4	5 assorted garments	11 1/2 *gin* 14 *še*	2 gin one-4th 11 1/2 še 6 silver per garment	NR	2:18:56
6	1 robe	5 1/2 *gin*	5 1/2 gin silver per robe	NR	5:30
7	16 1/3 ma-na X (wool?)	6 *gin* one-6th	Uncertain	NR	NR
8	2 *ban* 6 2/3 *sila* lard	1 1/3 *gin* 24 *še*	1 ban 4 2/3 sila 8 5/6 gin 10 še lard per gin silver	14:48:53:20	4:3

(continued)

Table 5.8 (continued)

AO 08463

I. Lines	II. In-kind value	III. In-silver value	IV. Unstated rate	V. In-kind rate SPVN	VI. In-silver rate SPVN
10	4 *bariga* 1 *ban* 2 *sila* oil	16 2/3 gin_2	1 ban 5 sila 7 gin 1/6 6 še	15:7:12	NR
22	A basket	15 *še*	15 še silver per basket	12	5
25	3 *gur* 3 *bariga* grain	2 5/6 *gin*	28 1/3 še per bariga oil	NR	9:26:40
26	7 *sila* premium oil	1 gin_2 10 še	Uncertain	NR	NR
30	8 *gur* 1 *bariga gur* 5 *sila* sesame	1/2 *mana*	1 bariga 2 ban 2 sila 1/6 per gin	1:22:10	NR

Table 5.9 Reciprocal pairs suggested in AO 08464

Reciprocal pair	Frequency	Lines
3 ~ 20	5	4–5, 10, 22–23, 28, 29–30
2 ~ 30	2	20–21, 24–25
15 ~ 4	2	2–3, 26–27
12 ~ 5	2	8–9, 11–15
18 ~ 3:20	1	6–7
1:30 ~ 40	1	18–19
1 to 1	1	16–17

Only line 22 would have involved a simple calculation in SPVN and with line 22 no calculation was necessary because only one item was purchased.

AO 08464 is attributed to *Itti-Sîn-milki*, merchant overseer of *Zarbilum*. The purpose of this text is a royal sacrifice. It may have belonged to the system of merchant intermediaries described in Chaps. 3 and 4. This, coupled with the appearance of specified rates that would have been very easy to work with in SPVN and reflect greater conformity when measurement values are transformed to SPVN than when left as measurement values, suggests that this text refers to commodities which are only evaluated in fixed rates of silver. These rates were perhaps established by the local *kārum* or merchant community. Silver was not necessarily used to procure these items. With AO 08463 a different phenomenon occurs. The text does not seem to be an official text but instead a merchant's own procurement of items. No reason can be derived from the text itself to suggest an administrative context. Values in silver seem independent of equivalency rates and are thus independent of a mathematical evaluation. It seems that this text reflects an actual exchange of silver for goods. While AO 08464 probably used SPVN as a tool in evaluating commodities in silver equivalents, AO 08463 clearly did not. AO 08464 is an estimation of value, that is, a calculated approximate value. AO 08463 is a statement of purchases, that is, an observed value.

A final note can be made on the types of administration in which the texts mentioned here are produced. The two labor accounts referred to above were probably produced by a bureau official of some kind, whether a temple or palace official. In addition, two households are discussed here, both unnamed. Five merchants are active in these texts, and they probably used SPVN as a tool in estimating value. Thus, if SPVN was used as a tool in calculation, then its use was probably not limited to one variety of archive—it was actively being used to estimate value in capital or labor for all three varieties of archive.

While this is not conclusive evidence for the use of SPVN in the calculation of all equivalencies and labor and, in fact, the distinction of AO 08464 and AO 08463 shows that SPVN was probably not used to produce all texts, equivalency and wage rates do seem to concentrate around certain SPVN numbers. Moreover, these numbers all appear on the standard reciprocal table used throughout southern Mesopotamia, as seen in Chap. 2, as well as in the standard head numbers of the multiplication tables as featured in Chap. 2. This all suggests that the conception of equivalency rates and prices in these examples were based on a few SPVN reciprocal pairs after transformation from measurement values into SPVN. This suggestion will be investigated further in Chap. 8. Finally, the reason for this may be a tendency toward conformity used to estimate value, whether of labor or of capital.

5.3 Explicit Statements of Sexagesimal Place Value Notation

The actual appearance of SPVN in the texts or on the tablets themselves is more elusive. While SPVN does occur, it only occurs rarely and the reasons for its use, as well as the nature of these numbers, can be difficult to suggest. Thus, for instance SPVN seems to appear in place of the total grain in LB 1092 and Ashm 1924-453. The author of these texts did add up the totals but for some reason transformed them to SPVN rather than stating the totals in their original measurement values. This is clear when transformation is made between the expected totals and the stated SPVN numbers found in the texts. The use of SPVN in these instances suggests that if the scribal curriculum as represented at Nippur and elsewhere reflects economic practice, measurement value was not necessary and that the totals transformed to SPVN were to be used in a subsequent calculation.

Indeed, for the Ur III period city of Umma, Ouyang and Proust (forthcoming) show that there are two uses of place value notation in the texts, both referring directly to a calculation: with partial-SPVN,[4] calculation is mainly subtractive and

[4]As stated in Chap. 2, Ouyang and Proust (forthcoming) coin the phrase partial-SPVN to describe systems of notation which are either partly sexagesimal, partly positional, or both partly sexagesimal and partly positional. This terminology is followed in this work as well.

possibly additive as well. SPVN proper refers to multiplication. Thus, a distinction is exhibited between addition and subtraction on the one hand and multiplication and division by means of multiplication on the other hand when partial-SPVN and SPVN are present on economic documents. SPVN is used for calculation with multiplication and thus the appearance of SPVN on a tablet usually refers to a multiplication. However, partial-SPVN at Ur III Umma refers to an addition or subtraction and this is also borne out in the texts studied here for the Old Babylonian period. This is probably the case for numbers in LB 1097.

LB 1097 is, unfortunately, an undated text that cannot be attributed to any specific archive. It is probably a household list projecting the costs of preparing a field for agricultural production. A marginal notation below and isolated from the text states 28:4:35 without any measuring unit or any other specification. It is probably the unstated total standing in for 28 *gur* 4 *bariga* 3 *ban* 5 *sila*. However, lines 18 and 19 of this text are broken, rendering this uncertain. The use of partial-SPVN can perhaps be attributed to the character of this total. It appears on the reverse of the text and would seem to be a grand total of the main text dealing with the preparation of a field as well as a supplementary section expressing additional expenditures related to, but not directly used, in field preparation. It may refer to another calculation that is to be carried out later. It is important to note that the only stated location in the text is the city of Umma, allowing the plausible conclusion that this text is from Umma or Umma's hinterland. Thus, partial-SPVN may have continued in use at Old Babylonian Umma in the same notation of capacity that was used in the Ur III period, as described by Ouyang and Proust.

This is, perhaps, underlined by the use of what seems to be a place value notation in LB 1091. There, a quantity is used, expressed in the same additive system, that could easily be mistaken for SPVN. This may, in fact, be two numbers, 10 and 56. This notation is written on the lower edge of the tablet and shows erasures as well as additional wedges, giving it the appearance of a scratch pad used for calculation. 56 is the unstated total of lines 2 through 4 and perhaps points to how calculation was carried out in the texts: 56, that is 5 *ban* 6 *sila*, was added to 1 *bariga*, and then 9 *sila*, the unstated total of lines five through eight added to this to produce the subtotal of line nine. We could even hypothesize that 9, corresponding to 9 *sila* was rounded up to 1 *ban* (10 in partial SPVN, which is also found at the bottom of LB 1091), added to 56, and then 1 removed from this total. This is, of course, conjecture, although it seems likely that partial-SPVN was used to facilitate calculation.

Table 5.10 Documents with partial-sexagesimal place value notation

I. Text	II. Subject	III. Archive	IV. Scribe	V. Year	VI. Location
LB 1091	Household costs in grain	Household	Scribe D	Reign of *Rīm-Sîn*?	Perhaps Larsa
LB 1097	Agricultural field preparation	Household	Scribe T	Uncertain	Perhaps Umma

In LB 1097 and LB 1091, partial-SPVN helps illuminate how calculation may have been carried out (Table 5.10). If practices suggested in Ur III Umma continued into Old Babylonian Umma, then perhaps an additive process was carried out in LB 1097. Moreover, this may explain the odd notation on LB 1091: it is part of a scratch pad used to store numbers temporarily in a simple addition. Partial-SPVN in LB 1097 would then be used to store numbers semi-permanently for a future addition, just as SPVN in LB 1092 and Ashm 1924-453 would be used for multiplication, while partial-SPVN in LB 1091 would have aided in calculation on the tablet itself. However, lack of a date in LB 1097 suggests that this text was supposed to become redundant at some point and thus, while partial-SPVN was more permanent, it was not meant as a permanent storage of information in this archive. Partial-SPVN is not SPVN but instead is directly based on the measurement values as expressed in the metrological lists. Partial-SPVN also helps to shed light on what exactly was learned by these individual scribes. Scribes using partial-SPVN to perform additive or subtractive functions were probably using values presented on the metrological lists, so that the use of partial-SPVN to represent capacity suggests familiarity with a metrological list for capacity learned in the elementary stage of scribal education.

Some examples show the probable use of SPVN in calculation (Table 5.11). LB 1092 and Ashm 1924-453 express the expected totals in SPVN, showing that metrology was not intrinsically important to the texts, but that these texts were produced for a later calculation which would probably have involved multiplication. This concurs with evidence derived from the mathematical education as it existed at Nippur, as well as a continuation of practices from the Ur III period. It is not surprising that these texts would have been produced for a later calculation if they are understood as parts of archives similar to those described in Appendix 2. Transparency is achieved by means of these texts, with each expenditure presented in the texts. The expenditures are the basis for the SPVN numbers used in calculation, even if a metrological total is not stated. Moreover, the use of SPVN in these texts also sheds light on the education of each scribe: they were familiar with metrological tables of capacity, which means they must have learned these and probably other tables in the course of their scribal education.

Table 5.11 Documents with sexagesimal place value notation in calculations

I. Text	II. Subject	III. Archive or bureau	IV. Scribe	V. Year	VI. Location
LB 1092	Various silver expenditures	Household	Scribe C	Reign of *Rīm-Sîn*?	Uncertain
Ashm 1924-453	Household costs in grain for two days	Household	Uncertain	No date	Uncertain
YBC 12273	Labor in a canal excavation	Bureau of irrigation and excavation	Scribe Q	*Hammu-rābi* year 38	Uncertain

In the texts studied so far, SPVN and partial-SPVN only appear on household lists. Moreover, year dates are lacking on each text. Days appear on Ashm 1924-453, and a day and month on LB 1091, while no date is mentioned in LB 1092 and LB 1097. These texts were temporary. They were meant to become redundant after a period or activity is completed, whether in the case of an activity such as LB 1097 where costs estimates are presented, upon a secondary calculation as with LB 1092, or when a new document was written, as is suggested by Ashm 1924-453, which would have become redundant when a weekly or monthly account was drawn up. They are each part of a specific record-keeping practice such as those outlined in Chap. 3.

This is in contrast to YBC 12273, presented in Chap. 8, on which an entire series of calculation seems to be expressed in SPVN. This text is firmly dated to *Hammurābi* year thirty-eight, while format and content show that it belonged to a bureau of irrigation and excavation. It probably shows SPVN at play in calculation within a bureaucratic setting. Indeed, this is the only economic text presented here, or anywhere, in which calculation is explicitly made in SPVN and the reason for this is uncertain. SPVN only appears to describe a process used to compute the volume measurement values that are used to estimate labor. Perhaps SPVN in YBC 12273 is a gloss meant to aid the scribe who may refer to this text later. Thus, these columns are intended to facilitate transparency. They also show that the author of YBC 12273 expected the reader to be able to infer what measurement values were intended with these SPVN numbers, a form of tacit knowledge.

5.4 Conclusions

Calculation within the economic texts can be difficult to reconstruct. Often the method used is ambiguous, as is evident from YBC 06216 and AUAM 73.2672, where it is not certain exactly how quantities are produced. Indeed, not all information used to produce totals or even merely to describe a transaction are visible in the texts as is evident from LB 1074, LB 1078, YBC 07744 and YBC 07787. However, the calculation in LB 1074 is easy to reconstruct and confirmed by the similar calculation in LB 1078, which belongs to the same archive and is probably the work of the same author. A discrepancy is witnessed in LB 1074 only when this calculation is carried out, showing that correct values are not always stated in the transactions that make up a total.

Ambiguity arises from the administrative nature of the texts themselves. Each text belonged to a specific archive and had a specific function. Thus, LB 1074 and LB 1078, both of the grain harvest archive, describe labor in the form of grain expenditures. Only the wage rates, man-days and subtotals found in these texts were needed. YBC 07744 only needed the original quantity, its silver value and the rates used to obtain this value. YBC 07787 needed neither. All the author of the text was

interested in was the silver equivalents. Perhaps the in-kind values were so conformed, based on custom and established practice, that they were not needed. Thus, tacit knowledge was probably at work in a given community, in this case a merchant community.

As a rule, scribes only stated information they deemed important in texts, so that calculation and the basis for this calculation was not always required for a text's construction. This makes it necessary to seek these calculations and their basis by other means. Above, the basis of calculations of rates is suggested as numbers in SPVN that are based on a tendency towards conformity by means of SPVN. This becomes visible when the stated rates are transformed to SPVN using the metrological tables discussed in Chap. 2. Once transformed to SPVN it is easy to see that these conformed rates were probably based on the standard reciprocal tables and multiplication tables as witnessed at Nippur and elsewhere throughout the kingdom of Larsa during the Old Babylonian period. While not certain for all equivalencies mentioned in the economic texts, it was shown, using AO 08464 as an example, that when rates are stated in an economic text, they are often transformed into SPVN numbers that appeared on the standard reciprocal tables and probably reflected an estimation of value based on calculation in SPVN. It was simple and easy for a merchant to work with a rate conformed by SPVN. When a merchant dealt with larger institutions such as the palace or even large temple estates, these conformed rates, assumed in calculation, generated a transparency to the Old Babylonian scribes that is not obvious today. By examining rates, a part of the education of each scribe can be described: in the course of his scribal education, each scribe who conceptualized a rate based on a SPVN reciprocal pair must have learned these reciprocal pairs, multiplication tables associated with these pairs and metrological tables used to transform measurement value to and from SPVN.

The plausible, if not probable, appearance of SPVN on YBC 12273 poses a conundrum at this point. If scribes only wrote information they deemed important in the text, and if SPVN is only used in calculation, while measurement values appear as numeric data to be exploited by the scribes, why does SPVN appear in this text where numeric data would normally appear? The point of this text was to estimate the cost of excavating a canal, so it can be suggested that SPVN was a kind of gloss meant to improve transparency. Indeed, the appearance of SPVN on LB 1092 and Ashm 1924-453, both undated, suggests this variety of gloss was a normal practice in some archives, reinforcing the hypothesis that the use of SPVN on YBC 12273 is a mere gloss, the result of a survey, and that the purpose of this text was to estimate labor *out of* volume, not an estimation of volume *and* labor.

While SPVN was probably not used to produce every text, nor can its use be proven with every apparent multiplication, there does seem to be a general tendency toward calculation by means of multiplication using SPVN. SPVN numbers were probably written on YBC 12273, leaving little doubt that in certain institutional environments SPVN was used in multiplication. The conformed equivalency rates as presented above show that calculation by means of SPVN was probably conceptualized using basic building blocks learned in the course of the scribal

education as attested in Chap. 2. Moreover, the existence of SPVN in place of the totals in some texts shows that these texts themselves were parts of record-keeping practices that involved calculation using SPVN. However, the use of partial-SPVN in texts makes it equally clear that not all texts used SPVN in calculation. This is especially true for those that only referred to or used addition and subtraction in their construction or that of their archive. Other tools were probably used, and it is these tools, as well as those used with SPVN, that will be explored in the following chapters.

Chapter 6
Errors, Mistakes and Evidence for a Counting Device

Abstract The purpose of this chapter is to explore how numerical discrepancies in texts can be exploited in order to explain how the numbers and measurement values in a text were produced. Four questions are introduced to explore the mathematics involved in the construction of each economic text: Is there any discrepancy in the text? If there is, what is its nature? Can this discrepancy or a similar discrepancy be found in other texts? Can this discrepancy be linked to a mathematical practice? Finally, what can this discrepancy tell us about the text's construction? To examine the strength of these questions, this chapter considers several economic texts, concentrating on one economic text in particular, YBC 04224, in order to show that an abacus existed in the Old Babylonian period to carry out basic addition with the metrological systems introduced in Chap. 2. The present chapter highlights the distinction between mistakes and errors proposed in Chap. 1 and goes on to explore mistakes.

While Chap. 5 explored whether the numeric or metrological basis of calculation in economic texts could be ascertained, another problem must be overcome as well: the ability to detect and exploit discrepancies in order to explain how a text was produced. While it was shown in Chap. 1 that Assyriologists in the past have attempted to exploit discrepancies as a means to explore practice, in so far as mathematics is concerned there is little mention of the nature of discrepancies or how they can be exploited to interpret the economic texts. For the purposes of this work, showing whether SPVN was used to construct texts is not relevant if discrepancies cannot be isolated and, more importantly, explained. In pursuit of this, and as an example, the question asked here is: can discrepancies provide evidence that a counting device was used in the production of some economic texts? This chapter's purpose is to explore how numerical discrepancies in texts can be exploited to explain how a text was produced. To answer this question, this chapter considers several economic texts, concentrating on one text in particular found on

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the tablet YBC 04224. Four questions related to this text help to explore the mathematics involved in its construction: is there any discrepancy in the text? If there is, what is its nature? Can this discrepancy or a similar discrepancy be found in other texts? Can this discrepancy be linked to a mathematical practice? And finally, what can this discrepancy tell us about the text's construction?

Beginning with the first question, it will help to recall that a discrepancy is a neutral term used to describe the difference between what is expected by the modern observer and what is stated in a text. For instance, looking at all the added sesame values in YBC 04224, there is a 7 *sila* difference between the extant total stated in line 26 and the expected total, which produces a 0.02 per cent difference.

In Table 6.1, the emphasis in bold denotes an unexplained discrepancy in the text. In addition to this discrepancy, a detailed examination of all added values in the silver expenditure and the itemized balance portions of YBC 04224 reveals multiple discrepancies that need to be explained (Table 6.2). 1 *gu* is omitted from the total expenditures found in lines 31 through 32: the author stated 7 rather than 8 in the calculation, which produces an 11.8 per cent difference. 1/3 *gin* is written in the balance found in lines 35 through 36, instead of 1/2 *gin*, which produces a difference of 0.003 per cent. There are significant discrepancies when the balance is compared to its itemization found in lines 39 through 52. This produces a 4.9 per cent difference between the expected total itemization of the balance and the extant balance. There are multiple discrepancies witnessed in simple statements of value as well as in basic added values.

It bears stating that, as shown here, discrepancies can be safely isolated when the author of a text makes an attempt at transparency. In YBC 04224 the author lays out for future reference all entries used to produce the totals as well as anomalies or unexpected changes in the total. This is seen in line 25 where 4 *gur* 2 *bariga* 3 *ban* were added to the subtotal of sesame values of line 24 after assessment (see Sect. 7.1.3 for this value assessment) to produce a grand total of sesame values in line 26. Thus, discrepancies can be isolated. However, can the nature of these discrepancies be proposed with any certainty?

Table 6.1 Addition of sesame values in YBC 04224

Expenditures: lines 15–26, sesame						
15			56 *gur*	1 *bariga*	4 *ban*	
16			26 *gur*	1 *bariga*	3 *ban*	5 *sila*
18			21 *gur*	3 *bariga*	3 *ban*	2 *sila*
20			31 *gur*		5 *ban*	
24	Subtotal	2 × 60	15 *gur*	2 *bariga*	3 *ban*	7 *sila*
25	When checked		4 *gur*	2 *bariga*	3 *ban*	
26	Extant total	2 × 60	20 *gur*			
	Expected total	2 × 60	20 *gur*			***7 sila***

Table 6.2 Addition of silver values in YBC 04224

Line	Notes	Quantity					
Expenditures: lines 13–36, silver							
13		8 *gu*	10 *mana*				
27	Equivalency, total 26		14 *mana*				
29			3 *mana*		11 *gin*	2/3 *gin*	18 *še*
31–32	Extant total	7 *gu*	27 *mana*		11 *gin*	2/3[*gin*	18]*še*
	Expected total	**8 *gu***	27 *mana*		11 *gin*	2/3 *gin*	18 *še*
35–36	Balance	1 *gu*	41 *mana*	2/3 *mana*	9 *gin*	1/3 *gin*	⸢3⸣*še*
	Expected balance	1 *gu*	41 *mana*	2/3 *mana*	9 *gin*	**1/2 *gin***	⸢3⸣*še*
Itemized balance: lines 35–52							
39			38 *mana*	2/3 *mana*	2 *gin*	5/6 *gin*	18 *še*
41			5 *mana*	1/2 *mana*			
44			30 *mana*	2/3 *mana*	2 *gin*	2/3 *gin*	15 *še*
47			1 *mana*	2/3 *mana*			
52			20 *mana*		15 *gin*		
35–36	Extant balance	1 *gu*	41 *mana*	2/3 *mana*	9 *gin*	1/3 *gin*	⸢3⸣*še*
	Expected itemized balance	1 *gu*	**36 *mana***	**5/6 *mana***		**2/3 *gin***	⸢3⸣*še*

6.1 The Nature of Discrepancies

In Chap. 1, two discrepancy types were proposed, mistakes and errors. There, a mistake is described as an unintentional deviation between the expected and stated values resulting from the scribe's own inattentiveness, while an error is understood as an intentional deviation, or at least the awareness of potential deviation, that resulted from the scribe's own computational culture acting on the scribe to produce an acceptable discrepancy. To illuminate whether a discrepancy is a mistake or error, and then examine how these discrepancies were produced and what they may say about a text's construction, it may help to explore whether there are other, similar discrepancies witnessed in other texts. Thus, after asking what are the natures of these discrepancies? It is helpful to ask the third and fourth questions, can these discrepancies or similar discrepancies be found in other texts? and following on from this, can these discrepancies be linked to mathematical practices?

For example, the first unexplained discrepancy occurred in line 26 where 7 *sila*, which should have been the final part of the measurement value, was omitted from the stated total. The capacity measurement value in line 26 is related to the weight measurement value in line 27. Lines 26 through 27 read as follows:

26	šu-nigin 2(geš$_2$) 2(u) gur še-giš-i$_3$	total 2 × 60 + 20 *gur* sesame
27	kar-bi 5(ban$_2$)-ta ku$_3$-bi 1(u) 4(diš) ma-na	its fixed rate 5 *ban* per (*gin* silver), its silver 14/ *mana*

This statement describes an equivalency. Multiple equivalencies are evident in YBC 07473, another balanced account dated to the reign of *Rīm-Sîn*, the last independent king of Larsa, where all goods are assessed in silver. The rates in this text, as well as equivalency rates in general, will be discussed more in Sect. 8.2. For now, one rate in particular found in lines 13 to 14 of YBC 07473, which evaluates a quantity of sesame in silver using the same vocabulary as is witnessed in YBC 04224, offers a clear example of rounding. Can this discrepancy be linked to a mathematical practice? In Chap. 8 a mathematical process of making equivalencies also appears in mathematical texts, such as YBC 04698, especially statement 3, for which see Sect. 8.2.2 and Appendix 1.B. Thus, there are precedents for equivalency calculation in economic texts and mathematical texts to compare with lines 26 and 27, while with YBC 07473 a discrepancy probably resulted from rounding.

In YBC 04224: 26–27, a quantity of sesame is assessed in silver by means of a stated rate, 'kar-bi', 'its rate'. The rate starts with the total quantities of sesame, assessed by capacity and stated in lines 15 through 25. The total stated in line 26, $2 \times 60 + 20$ *gur*, was used to produce the equivalency in silver, 14 *mana*, using the rate provided, 5 *ban* per *gin* silver. If, however, this multiplication had been carried out with the expected total, $2 \times 60 + 20$ *gur* 7 *sila*, the multiplication would have been more complicated and the result would have been 14 *mana* 25 one-5th *še* silver. Thus, it is safe to suggest 7 *sila* was truncated from the expected total of $2 \times 60 + 20$ *gur* 7 *sila* in order to obtain the extant total of $2 \times 60 + 20$ *gur* found in line 26, which was then used to make the equivalency found in line 27. Truncation implies intent and is thus an error.

7 *sila* was probably truncated off the end of line 26, which also suggests that the placement of a discrepancy can help to understand its nature. If the discrepancy is found at the end of a measurement value it can potentially be intentional, the result of rounding. This is supported by the small percentage difference between expected and stated values (0.02 per cent). Turning to lines 31 through 32, in the total expenditures, 7 *gu* is written, rather than the expected 8 *gu*, at the beginning of the measurement value. A similar, although more extreme discrepancy occurs in another text, YBC 07195, which dates to *Rīm-Sîn* of Larsa's sixth year in power. In line 34 the author omitted an entire arithmogram, 2(u), which resulted in a significant reduction of 20 *gur* in the expected balance, 24 *gur* 1 *bariga*, or an 82.64 per cent difference. This mistaken omission of 20 *gur* is probably the case because it is not carried through the text; the other totals are correct while the rest of the number in line 34 is correct. '2(u)' should appear as the head arithmogram, that is, the number at the beginning of the measurement value. It is difficult to see how this omission could be a mistake in calculation and it is thus probably a mistake in writing or an epigraphic mistake.

Similar to YBC 07195, the author of YBC 04224 simply omitted a single wedge, 1(aš), part of the head arithmogram, resulting in a discrepancy of 1 *gu*, a significant 11.8 per cent difference. This discrepancy is not carried through the text but is limited to lines 31 through 32; it occurs at the beginning of the measurement value and not at the end like rounding, and so it does not seem to be intentional nor the result of calculation. It is probably a simple epigraphic mistake as well.

6.2 An Abacus?

The remaining discrepancies found on YBC 04224 are more difficult to explain. As stated above, in the balance found in lines 35 through 36 of this text, 1/3 *gin* is written instead of 1/2 *gin*, which produces a difference of 0.003 per cent (Table 6.3).

When this balance is compared to the itemized balance, that is, the list of distributions made to the various merchants stated in lines 39 through 52, the difference grows to 4.9 per cent. The stated balance in lines 35 through 36 is 1 *gu* 41 2/3 *mana* 9 1/3 *gin* 3 *še*. The expected itemized balance, if all values in lines 39 through 52 are added correctly, is 1 *gu* 36 5/6 *mana* 2/3 *gin* 3 *še*, a difference of 4 5/6 *mana* 8 2/3 *gin* (Table 6.4).

In calculating the balance, that is, when subtracting the total expenditures from the total capital, the author wrote 1/3 instead of 1/2 *gin*. When compared with the itemized list of distributions from the balance found in lines 39 through 52, this becomes very interesting. There is a 30 *še* or one-6th *gin* difference between the 1/2 *gin* expected in the balance and 2/3 *gin* expected of the total of itemized distributions made from this balance listed in lines 39 through 52. The total of *še*, when added together, would be 33 *še*, 30 *še* of which would have been expressed as one-6th *gin* and then carried over and appended to 1/2 *gin* to produce 2/3 *gin*. If the author intended to write 1/2 *gin* rather than the stated 1/3 *gin*, then it can be suggested he did not carry 30 *še* to produce 2/3 *gin* but instead left it at 1/2 *gin* (Table 6.5).

Table 6.3 Subtraction in YBC 04224

Capital against expenditures							
11	Total capital	10 *gu*	9 *mana*		1 *gin*	One-4th	6 *še*
31–32	Extant total expenditures	7 *gu*	27 *mana*		11 *gin*	2/3[*gin*	18]*še*
	Expected total expenditures	**8 *gu***	27 *mana*		11 *gin*	2/3 *gin*	18 *še*
35–36	Balance	1 *gu*	41 *mana*	2/3 *mana*	9 *gin*	1/3 *gin*	˹3˺*še*
	Expected balance	1 *gu*	41 *mana*	2/3 *mana*	9 *gin*	**1/2 *gin***	˹3˺*še*

Table 6.4 Addition and expected addition in YBC 04224: 35–52

Itemized balance: lines 35–52							
39			38 *mana*	2/3 *mana*	2 *gin*	5/6 *gin*	18 *še*
41			5 *mana*	1/2 *mana*			
44			30 *mana*	2/3 *mana*	2 *gin*	2/3 *gin*	15 *še*
47			1 *mana*	2/3 *mana*			
52			20 *mana*		15 *gin*		
35–36	Extant balance	1 *gu*	41 *mana*	2/3 *mana*	9 *gin*	1/3 *gin*	˹3˺*še*
	Expected itemized balance	1 *gu*	**36 *mana***	**5/6 *mana***		**2/3 *gin***	˹3˺*še*

Table 6.5 Addition and expected addition in YBC 04224: 35–52

Addition of *še* measurement values	
Addition of stated *še* measurement values	18 *še* + 15 *še* = 33 *še*
Translation to fraction of *gin* measurement values	33 *še* = **one-6th *gin*** 3 *še*
Addition of fraction of *gin* measurement values	
Addition of stated fraction of *gin* measurement values	5/6 *gin* + 2/3 *gin* = 1 1/2 *gin*
Addition with one-6th *gin* carried over	1 1/2 *gin* + **one-6th *gin*** = 1 **2/3** *gin*

Table 6.6 Additions by *gin* and fraction of *mana* measurement values in YBC 04224

Addition of *gin* measurement values	
Addition of stated *gin* measurement values	2 *gin* + 2 *gin* + 15 *gin* = 19 *gin*
Addition with 1 *gin* carried over	19 *gin* + **1 *gin*** = **20 *gin***
Translation to fraction of *mana*	20 *gin* = **1/3 *mana***
Addition of fraction of *mana* measurement values	
Addition of stated fraction of *mana* values	2/3 *mana* + 1/2 *mana* + 2/3 *mana* + 2/3 *mana* = 2 1/2 *mana*
Addition with 10 *gin* carried over	2 1/2 *mana* + 10 *gin* = 2 2/3 *mana*
Addition with 1/3 *mana* carried over	2 1/2 *mana* + **1/3 *mana*** = 2 **5/6** *mana*

Bold in Table 6.5 denotes carrying mistakes and expected values if carrying were done as expected. This mistake in adding together an itemization of the balance would then suggest that written 1/3 *gin* in the stated balance is a simple epigraphic mistake and the author meant to write 1/2 *gin*. A carrying mistake could also explain the 1 *gin* difference between 2/3 *mana* 9 *gin*, the stated balance, and 5/6 *mana*, the expected itemized balance: the author did not carry 1 *gin* to produce 5/6 *mana* (Table 6.6).

In addition to these carrying mistakes, there is a 5 *mana* difference between the stated balance and the balance's total itemization. Perhaps 5 *mana* in line 41 was added twice. See Table 6.7 for this. In Table 6.7, underlined values represent a reconstructed value that is not found in the text. When adding values together, the author seems to have trouble carrying values between metrological elements, namely number of *še* and fraction of *gin* and then fraction of *gin* to whole *gin*. Can similar discrepancies be found in other texts?

6.2.1 Carrying in Other Texts

A similar phenomenon is, perhaps, witnessed in LB 1074 already discussed in Chap. 5, which is dated to *Rīm-Sîn*'s thirty-eighth year. LB 1074 reports costs of agricultural activity in the field of *Agakkum*, the location of which is uncertain. The

Table 6.7 Additions of the number of *mana* in YBC 04224

Addition of *mana* measurement values	
Addition of stated *mana* value	38 *mana* + 5 *mana* + 30 *mana* + 1 *mana* + 20 *mana* = 1 *gu* ***34 mana***
Addition with 2 *mana* carried over	34 *mana* + 2 *mana* = 1 *gu* ***36 mana***
Proposed addition of *mana* values	38 *mana* + 5 *mana* + 5 *mana* + 30 *mana* + 1 *mana* + 20 *mana* = 1 *gu* ***39 mana***
Proposed addition with 2 *mana* carried over	1 *gu 39 mana* + 2 *mana* = 1 *gu* 41 *mana*

first four entries do not state measurement values of grain, although each entry states a wage rate, which will be discussed in Sect. 8.3, to record cost per person per day. The total of these first four unstated values appears in line 8. If the wage rates are computed correctly, then there is a discrepancy of 1 *bariga* in line 8, a difference which is transmitted through the rest of the text (Table 6.8).

In LB 1074 the mistake occurs only with numbers that are not stated in the text but are implied by calculation of rates. Because the lowest measurement value present corresponding to the *ban* measure and the highest measurement value present corresponding to the *gur* measurement values are correct, this value was probably not a mistake in calculation by wage rates but instead a mistake in addition. These numbers could have been stored by means of tokens, perhaps part of an instrument such as an abacus, or perhaps on a clay scratch pad. Grain would have been computed out of the numbers of men and the wage rate in grain, and then this quantity set aside in the form of tokens or marks on clay until all the quantities

Table 6.8 Calculation by addition in LB 1074

Line	Notes	Grain			
1		2 *gur*	4 *bariga*	2 *ban*	
3		1 *gur*		2 *ban*	
5				5 *ban*	
6				2 *ban*	
8	Extant subtotal	4 *gur*	1 *bariga*	5 *ban*	
	Expected subtotal	4 *gur*		5 *ban*	
10			1 *bariga*	4 *ban*	
12				1 *ban*	4 *sila*
13				1 *ban*	
14					6 *sila*
15				5 *ban*	
16	Subtotal		3 *bariga*		
18	Extant total	4 *gur*	4 *bariga*	5 *ban*	
	Expected total	4 *gur*	***3 bariga***	5 *ban*	

Table 6.9 Stated and expected addition in LB 1074

Expected addition and carrying: 2 *ban* + 2 *ban* + 5 *ban* + 2 *ban* = 11 *ban* 11 *ban* = 1 *bariga* 5 *ban* 4 *bariga* + 1 *bariga* = 1 *gur*
Addition with mistaken carrying: 4 *bariga* + 2 *bariga* = 1 *gur* 1 *bariga*

to be added together had been computed. Third, addition was carried out using these tokens or marks. The discrepancy would be a mistake in translating 11 *ban*, expressed with tokens or marks, into 1 *bariga* 5 *ban*: the scribe mistakenly produced 2 *bariga*. This could be a mistake in carrying numbers between metrological elements (Table 6.9).

Difficulty appears at this point. Was the mistake in transmission the result of an improper translation of measurement values represented by tokens between places on some kind of abacus, or the result of mental calculations of marks on a scratch pad followed by translation to the text?

6.2.2 *Evidence for Addition in Mathematical Texts*

To answer this, it may help to look into the mathematical tradition. Can evidence be found for an abacus or a scratch pad in mathematical texts? Proust, in her 2000 article, uses mistakes in several numerical texts to explain discrepancies in AO 06456 and Plimpton 322. According to Proust, three varieties of discrepancies occur when calculating with SPVN in AO 06456, a tablet dated to the Hellenistic period[1]: one number is written where two numbers are expected.[2] A null-marker is mistakenly added between two components of a number.[3] Finally, a component of a number, including expected null-markers, is mistakenly omitted[4] (Proust 2000: 298–299).[5] These are all mistakes in relative magnitude. Because in the Old Babylonian period there was no null-marker to reflect magnitude while using SPVN, the phrase 'relative magnitude' is preferred here to state the scribe's

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[1]As is seen with this text and the study of it, first by Thureau-Dangin (1922: plates 55–58), then Neugebauer (1935–1937: I 14–22), Bruins (1970) and finally Al-Rawi and Friberg (2016: 43–50), by the Hellenistic period SPVN had developed a null-marker to express magnitude within a number itself, a significant innovation in representing SPVN. Here this null-marker is represented by a '0'.

[2]Such as 54 instead of the expected 14 and 40 (Proust 2000: 297).

[3]Thus, instead of the expected 2:16:41:15, the author wrote '2:16:41:0:15' (*ibid.*: 298).

[4]Such as '40:21:42:41:*:9' for the expected '40:21:42:41:**0**:9' or '1:58:36:15' instead of the expected '1:58:3**9:8:26**:15' (*ibid.*: 298).

[5]See also Al-Rawi and Friberg (2016: 44–45) where these mistakes are reviewed while discussing AO 06456.

understanding of a number's components relative to the entire number itself. A mistake in relative magnitude would then be a mistake where the scribe, for instance, adds a cycle of sixty between two components or removes a cycle of sixty between components of a number. Thus, two numbers reflecting two different cycles of sixty would be mistakenly added together. To Proust (*ibid.*: 298):

> Ces erreurs ont pour points communs d'intervenir en position médiane (en général, dans la partie centrale du nombre) et dans des nombres à plus de quatre chiffres.

These mistakes are explained when they are compared to N 3958, an Old Babylonian numerical text from Nippur in which numbers are successively doubled starting with 2:5, then 4:10 and up to thirty-six doublings. In N 3958 calculation after line 21 is cut into two parts, starting with 10 + 6:48:53:20 then 20 + 13:37:46:40 and so on up to 1:31:1:20 (+) 1:2:1:47:51:6:40 in line 36. Addition symbols separate elements from lines 21 through 30 and then are omitted even though this system of cutting in two is certain and made evident by placement of numbers over two lines.

As Proust (2000: 302) proposes, a multiplication was actually performed and a form of abacus was probably used to accomplish this multiplication. When a multiplication grew beyond five place values, it was cut in two, each part was multiplied separately, and the products then added together:

> En résumé, toutes les erreurs décrites ici pourraient être des erreurs de raccordement dues à un mauvais repérage des positions relatives des deux nombres à ajouter : ce sont les cicatrices du recollement des deux morceaux séparés à partir de cinq chiffres. On peut même percevoir dans AO 6456 des recollements de trois morceaux.

Addition was just one step in multiplying larger SPVN numbers. The primary evidence for this is in mistakes, especially in addition where the scribe did not add the correct place values together (Proust 2000: 300–301). This is because an abacus of this kind would have been drawn in the sand or made of perishable materials, while the counters themselves would be unidentifiable, so that it would not be identifiable in the archaeological record.[6] Unfortunately, as Proust (*ibid.*: 302) admits, she is unable to reconstruct exactly how the device worked.

However, this abacus is also a topic of interest for Jens Høyrup who, supporting Proust's discussion, points to its existence since the middle of the third millennium. Discussing Ur III administrative reforms, he states: 'The detailed calculation of a national economy is, and was, no easy matter. Additions and subtractions could be

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[6]See Proust (2000: 302). A similar situation is suggested by Netz (2002) for Greek abaci (as distinct from Roman abaci): simple pebbles worked as counters while counting boards themselves would have been made of wood. Netz (2002: 327) states, 'Ultimately, indeed, the very notion of the abacus as a clearly defined artifact is misleading. While scratches are useful, the lines can very well be imagined, perhaps referring to whatever irregularity the surface at hand may have. Thus any surface will do. The abacus is not an artifact: it is a state of mind. The western abacus was wherever there were sufficiently flat surfaces—as well as sufficiently many objects that the thumb and fingers could grasp'.

made by traditional means—at least since the mid-third millennium, some kind of abacus (called "the hand" in agreement with its possession of five sexagesimal levels) had been in use' (Høyrup 2007: 262). Discussing SPVN, Høyrup (*ibid.*: 263) further notes there is no need to invent a place value system since the principles of place value were inherent in an abacus. Thus, there is mathematical evidence for an abacus at play; it had existed since at least the middle of the third millennium and would continue to exist into the first millennium BCE, even if the exact nature of such a device cannot be explained by the mathematical tradition alone.

6.2.3 Abacus and Administrative Practice

If an abacus did exist, as hypothesized by Proust and corroborated by Høyrup, then it is plausible to suggest the use of a similar instrument in carrying out calculation in YBC 04224. As Høyrup notes, the principles for using SPVN were inherent with an abacus. However, operations in SPVN using an abacus were probably set up and carried out in a different manner than would be expected with measurement values. This is because with SPVN, an abacus or other counting device would be used to assist in multiplications with many place value numbers. This begs the question: was there a system similar to SPVN that could be used with measurement values?

Chapters 2 and 5 above pointed to the use of partial-SPVN systems in addition and subtraction. According to Ouyang and Proust (forthcoming), subtraction in Nik. 2 402, a balanced account from the Ur III city of Umma, produces a deficit between capital and expenditures in which discrepancy was produced due to the carrying over between the various metrological elements, which included fractions, in a complex process. This may have been facilitated by the transformation of measurement values into partial-SPVN before and after calculation. Calculation was possibly carried out using some form of calculation device, and thus the shape of partial-SPVN is representative of the shape of counters. This form of notation, when it appears in the margins of the text, helps to record the translation of measurement values from the text to a counting device or vice versa (*ibid.*).

Chapter 5 showed the existence of this system during the Old Babylonian period in texts like LB 1097. In this text, 28 appears on the left followed after a space by 4:35. These numbers possibly combine to form 28:4:35, corresponding to 28 *gur* 4 *bariga* 3 *ban* 5 *sila*, which is perhaps the unwritten total of capacity measurement values of grains stated in this text. 28:4:35 would then conform to a partial-SPVN system for capacity (Table 6.10). Numbers would correspond to values found in the capacity system so that units 1 through 9 correspond to *sila* measures, while 10 through 50 correspond to *ban*. *bariga* is only expressed up to 4, 5 being equivalent

Table 6.10 Partial-sexagesimal place value notation for capacity system

Measurement value	Partial-SPVN Transformation
1–9 *sila*	1–9
1–5 *ban*	10–50
1–4 *bariga*	1–4
1–59 *gur*	1–59

to 1 *gur*. Beyond *bariga*, 1 through 59 represent *gur* measures.[7] Thus, it is safe to suggest that partial-SPVN still existed in the Old Babylonian period. If true, this would show measurement values in LB 1097 were transformed into partial-SPVN in advance of calculation. However, before this can be confirmed, the space between 28 and 4:35 must be explained.

Ouyang and Proust (forthcoming) point out that the partial-SPVN witnessed in Nik. 2 402 may have been conceived of as two different numbers. On the one hand the number seen there has a space, on the other hand it is not properly aligned. In addition, the space separates *gin*, which holds a sexagesimal relationship with *mana*, from *še*. The relationship between *gin* and *še* was perhaps conceived of as three sets of sixty *še* per *gin*. The space may separate units that hold a sexagesimal relationship between each other and units that hold a partially-sexagesimal relationship between each other. This could help explain the space in LB 1097. It was conceived as two numbers which are divided along similar lines: the number 28, which is sexagesimal in structure, and the number 4:35, which is partially sexagesimal. Does this split occur with measurement values in other texts? If so, it would suggest a similar structure used in calculation with measurement values.

Ashm 1923-340 and Ashm 1922-277 both offer a curious division of values between lines, which may be similar to the spatial division witnessed with the partial-SPVN number in LB 1097. Both Ashm 1923-340 and Ashm 1922-277 are of uncertain provenance, although based on place names mentioned in the texts, they may have been produced in the city of Ur. They both have a tabular layout, both present similar subject matter, and both were produced in the same year, the thirty-fifth year in power of *Hammu-rābi* of Babylon, that is, after he conquered Larsa. It is thus safe to suggest that the two texts were produced in the same bureau. This bureau probably oversaw agricultural activity on lands belonging to the temple of Nanna at Ur. The scribe in question, scribe P, is predicting yields in preparation for planting.

With Ashm 1923-340, several discrepancies appear. The total for lines 8 through 18 in column 7 is stated as 31 *gur* 4 *bariga* 1 *ban*. 31 *gur* is written in line 21 while 4 *bariga* 1 *ban* is written in line 22. *gur* is clearly separated from *bariga* and *ban*. There are two discrepancies in this total as seen in Table 6.11. The first is the addition of 1 *ban* to the end of the total, while the second is the omission of 2 *gur* at

[7]The use of diš for *gur* measure shows a deviation from Ur III texts in which aš is still used in partial-SPVN (cf. Ouyang and Proust, forthcoming).

Table 6.11 Addition of grain in column 7 of Ashm 1923-340

Line	Notes	Quantity			
8			4 *bariga*	1 *ban*	
9		8 *gur*	1 *bariga*	4 *ban*	
10		4 *gur*		5 *ban*	
11				2 *ban*	5
12		1 *gur*	2 *bariga*	**2 *ban***	
13		1 *gur*			
14		1 *gur*	3 *bariga*	2 *ban*	
15		6 *gur*	1 *bariga*	1 *ban*	5
16		2 *gur*	2 *bariga*	3 *ban*	
17		4 *gur*		5 *ban*	
18		3 *gur*	1 *bariga*	4 *ban*	
21	Extant total lines 8–17	31 *gur*			
22			4 *bariga*	1 *ban*	
	Expected total	3**3** *gur*	4 *bariga*		

the beginning of the total. These both seem to be simple mistakes. Moreover, the final mistake, addition of 1 *ban* to the total, is solved if a mistake calculating the yield of line 12 (written in bold) is corrected to 3 *ban*. A third discrepancy appears in the total of column 3, lines 21 through 22 of Ashm 1923-340, as is shown in Table 6.12. The author wrote 37 *gur* 1 *bariga* rather than the expected 37 *gur* 5 *ban*. The author rounded up by 1 *ban*, which produced a negligible difference of less than 0.08 per cent but did not feel it appropriate to round down by 1 *ban* in column 7 of the same text, which would have produced a negligible 0.10 per cent difference.

Ashm 1922-277 provides a clue as to why totals were divided as they were in Ashm 1923-340. The author of this tabular text divides subtotals and totals of area into two parts: *bur* and above are typically written in one line, while just under this appears *eše* and below. The measurement unit *sar* is often omitted. For example, lines 25 through 26 of column 1 is divided as is typical into two parts. In the first part, line 25, 5 *bur'u* 9 *bur* is written, while in line 26, 1 *eše* 5 *iku* 20 is written; 20 is presumably associated with *sar*.

As shown in Chap 2, where area was expressed by both the *sar* system and with system G, between *bur* and *sar* the structure is not sexagesimal while at *bur* and above it is. Addition may have been carried out following this split in Ashm 1922-277; values at and above *bur* and at and below *eše* may have been added up separately and two area totals produced. Once addition was carried out, both parts may have been appended together to produce the totals seen in the texts. The author divides the total exactly along these lines, *bur* and above appear in line 25 while *eše*

Table 6.12 Addition of grain in column 3 of Ashm 1923-340

	Notes	Quantity			
8			4 *bariga*	1 *ban*	
9		8 *gur*	1 *bariga*	4 *ban*	
10		4 *gur*		5 *ban*	
11				2 *ban*	5
12		1 *gur*	2 *bariga*	3 *ban*	
13		1 *gur*			
14		1 *gur*	3 *bariga*	2 *ban*	
15		6 *gur*	1 *bariga*	1 *ban*	5
16		2 *gur*	2 *bariga*	3 *ban*	
19		10 *gur*	4 *bariga*	1 *ban*	
21	Extant total	37 *gur*			
22			1 *bariga*		
	Expected	37 *gur*		**5 *ban***	

and below appear in line 26. Subtotals and totals throughout the text give the appearance that they were calculated in two parts and appended together. These splits do not appear in individual entries.[8]

With capacity, calculation could also have been split in two parts, at least in Ashm 1923-340. Under this hypothesis, upper level calculations were solely in *gur*, while lower level calculations were in *bariga* and below. This took advantage of a split in the capacity system. *gur* and above were represented using system S. However, from *sila* to *bariga*, capacity is only partially sexagesimal. In Ashm 1923-340, the author split measurement value into a lower and an upper part, each part to be added separately based on this split. In column 3, he rounded 5 *ban* of the lower part of the number up to 1 *bariga*. He then appended the rounded value of 4 *gur* 1 *bariga* to the total upper value of 33 *gur* to produce 37 *gur* 1 *bariga*. Rounding simplified the statement—only one wedge, corresponding to 1 *bariga* was needed in the lower value. This in turn simplified appending the two values together. Yet the author still felt a need to keep 1 *bariga* in the lower level, rather than place it next to *gur* measurement values of the upper level (where there is space for 1 *bariga*), suggesting that he saw two separate numbers, just as was argued for Nik. 2 402. This perhaps explains why the author did not truncate the value in column 7: it did not simplify the statement as it did in column 3. When the author rounded 5 *ban* up to 1 *bariga* in column 3, he significantly reduced the

[8]Note that this split does not appear in relation to area in Ashm 1923-340. However, it must also be noted that only *eše*, *iku*, *ubu* and *sar* measurement values are added together. *bur* only appears in totals as the result of addition. There are no upper values to add together. Thus, the author needed only to state the total of lower values without appending these values to the results of an upper value addition.

complexity of this number. If 1 *ban* was truncated off in column 7 there would still have been a lower value of 4 *bariga*.

In both Ashm 1923-340 and Ashm 1922-277, measurement values are divided between lines based on splits in the metrological systems for area and capacity. Partial-SPVN on LB 1097 was similarly partitioned based on a split in the measurement systems so that one gets the impression that a similar device was used to carry out addition in each text. Division into two numbers may have made it easier to use an abacus. As noted by Proust (2000: 300–301), an abacus was probably limited to 5 places when multiplying with SPVN. If a similar device was used to calculate addition with partial-SPVN for each metrological system, it may have had a similar place limit as well. Each split would have served as natural points to divide up addition so that at any moment the author was only adding a fixed number of places.

6.3 Conclusions

What can discrepancies reveal about YBC 04224's construction? First, simple mistakes in writing reflect a somewhat rushed hand. The author omitted 1 *gu* weight, stating 7 rather than 8 *gu* in the total of lines 31 through 32. In the same way he wrote 1/3 *gin* rather than 1/2 *gin* in the balance of lines 35 through 36. However, it is clear what the author intended so that addition in these lines was probably carried out correctly. More importantly, these simple mistakes in writing calculated values suggest the author was compiling the text from data at hand and not from a scratch pad—he did not have an earlier draft to work from and to review for mistakes.

An interesting error occurred in line 26 where the author truncated the measurement value, removing 7 *sila* from the total of 22 *gur* 7 *sila* of sesame, which resulted in a 0.02 per cent difference. In line 27, this total was used to produce an equivalency in silver of 14 *mana*. Because the stated total of sesame was clearly used to produce the equivalent silver, rather than the expected total before truncation, it is safe to state that the author calculated the equivalency himself and was not using the result of a prior series of calculations. The stated silver equivalency reflects the stated total for sesame and not each individual entry for sesame. The author seems to have been carrying out calculations while writing the text, not in advance of the text.

Finally, the author made a series of mistakes when adding together the itemization of the balance. The author had trouble carrying numerical values between metrological elements, namely numbers of *še* and fractions of *gin* and then fractions of *gin* to whole *gin*. Mistakes in carrying occurred in other texts, such as LB 1074. It was proposed that these mistakes resulted from an improper translation of values between places on an abacus or from a scratch pad to the text. This led to the question: was a counting device or a scratch pad used to produce this text? First, as

Table 6.13 Addition in two parts for Ashm 1922-277

Line		Upper level addition		Lower level addition			
		bur'u	*bur*	*bur*	*eše*	*iku*	*sar*
18	Subtotal, 11 + 17	3 *bur'u*	5 *bur*		1 *eše*	4 *iku*	10
21			⸢8 *bur*⸣			3 *iku*	
22–23		1 *bur'u*	5 *bur*		2 *eše*	4 *iku*	10
25–26	Extant total, 18–23	5 *bur'u*	8 *bur*	1 *bur*	1 *eše*	5 *iku*	20
5 *bur'u* 8 *bur* + 1 *bur* 1 *eše* 5 *iku* 20 = 5 *bur'u* 9 *bur* 1 *eše* 5 *iku* 20							

just suggested for YBC 04224 at least, no prior draft was used to write this text, so it seems less likely that a scratch pad would have been used.

Partial-SPVN in LB 1097 suggests that an abacus may have existed in the Old Babylonian period. In Ashm 1922-277 and Ashm 1923-340, totals and subtotals were dispersed between lines following natural splits in the capacity and area systems, so that if calculation was carried out using some kind of device it was carried out in parts to fit on an instrument of limited size. That is to say, in preparing to use an abacus, the author of each of these texts would have divided measurement values along natural splits in their metrological systems in order to simplify and facilitate calculation with an abacus. Examples of addition based on these splits are provided by Tables 6.13 and 6.14.

Was there a similar partitioning in YBC 04224? In this text, carrying mistakes occur between metrological elements below *mana*, while at *mana* there is a repeated addition. Let us recall from Sect. 2.1.2 that *še* and *gin* are common to weight, capacity and area, forming a natural split in the weight system. There is a

Table 6.14 Addition in two parts for Ashm 1923-340

Line	Notes	Upper level addition	Lower level addition			
		gur	*gur*	*bariga*	*ban*	*sila*
8				4 *bariga*	1 *ban*	
9		8 *gur*		1 *bariga*	4 *ban*	
10		4 *gur*			5 *ban*	
11					2 *ban*	5
12		1 *gur*		2 *bariga*	3 *ban*	
13		1 *gur*				
14		1 *gur*		3 *bariga*	2 *ban*	
15		6 *gur*		1 *bariga*	1 *ban*	5
16		2 *gur*		2 *bariga*	3 *ban*	
19		10 *gur*		4 *bariga*	1 *ban*	
	Expected totals	33 gur	4 *gur*		***5 ban***	
	Rounded up to	33 gur	4 *gur*	1 *bariga*		
33 gur + 4 *gur* 1 *bariga* = 37 *gur* 1 *bariga*						

Table 6.15 Potential layout of counting device for weight

Measurement units	*gu*	← 60	*mana*	← 60	*gin*		← 180	*še*		
	Upper level addition					Lower level addition				
Measurement values	1–59 *gu*		1–59 *mana*		1/3–5/6 *mana*	1–19 *gin*		One-6th-5/6 *gin*		1–29 *še*
Partial-SPVN	1–59		1–59		20–50	1–19		10–50		1–29

distinction, then, between an extra iteration of addition as it was carried out with a counting device which occurs at *mana*, and transmission of values between metrological elements on this counting device which occurs below *mana*.

While there are 180 *še* in 1 *gin*, this can be understood as six sets of 30 so that the author would have needed to carry over 30 *še* to the one-6th *gin* column. The same can be said for *gin*: while there are 60 *gin* in a *mana*, actors typically only used 1 through 19 *gin*, after which 1/3 *mana* was used. *še* measurement values could further be divided in half but there are no half-*še* measurement values in YBC 04224 so that these would not have been necessary to count.[9] Full *še* made up the lowest level on the device, from 1 through 29. Next was 10 through 50, corresponding to one-6th through 5/6 *gin*. Above this was 1 through 19, representing whole *gin*, while 20 corresponded to 1/3 *mana*. (Table 6.15)

Because there is a split between whole *gin* and then fractions of *mana* (or *sila*, or *sar*), one expects that two places would be taken by these values: one place for whole *gin* which would have been added with lower addition, and one place for fractions of *mana* which would have been added with upper addition. The shapes of the numbers themselves, as described in Chap. 2, suggest further divisions: units 1 through 9 of *še*, *gin* and *mana* were represented by the 'diš' sign, while units of 10 for each were represented by the 'u' sign so that it can be hypothesized that 10's and units of *še*, *gin* and *mana* were calculated separately.

This may suggest that the author added in two parts. First, he may have transformed values below fractions of *mana* to partial-SPVN and carried out addition by column on an abacus, transferring values as needed from one column to another. *še* measurement values were added first. Each *še* took up two places—one place for units of *še*, represented by up to nine counters, and one place for 10's of *še*, represented by two counters. The author would tally up units of *še* first, remove every full 10 *še* and replace it with a counter in the 10's of *še* place. These would be added next, where every time three 10's of *še* counters appear, they would be removed and a counter would be added to the place occupied by fractions of *gin* counters. These fractions of *gin* counters, in turn, represented one-6th *gin* each, which would be added up next; every six of these counters would be removed and then a counter would be added to whole *gin*. *Gin* would again take up two places—one for counters representing units 1 through 9 and one for 10's of *gin*. Every 10

[9]See Chap. 2 for this.

whole *gin* would be removed and a counter for 10’s of *gin* would be placed with 10’s of *gin*. However, because there are only 20 *gin* in a fraction of a *mana*, every two 10’s of *gin* would be removed and tallied as fractions of *mana*. Fractions of *mana* would transfer to the lowest value of the upper division, so this would be set aside. Thus, only five places would appear on the lower level: units of *še*, 10’s of *še*, fractions of *gin*, units of *gin* and 10’s of *gin*.

The author may have performed a similar operation for an upper level addition as well, starting with fractions of *mana* and above. Here, counters representing fractions of *mana*, that is sixths of *mana*, make up the lowest place on the abacus. Five of these appear in this column. Units of *mana*, represented by up to nine counters, appear next, followed by counters representing 10’s of *mana*, up to five of these. This is followed in turn by counters representing single units of *gu*, up to nine counters, and 10’s of *gu*, up to five counters. Thus, this upper level addition only consisted of five possible places as well: fractions of *mana*, units of *mana*, 10’s of *mana*, units of *gu* and maybe 10’s of *gu* if the author had reached this value. Once addition of the lower part and then addition of the upper parts were carried out, the author would have appended the two totals together.

Table 6.16 presents a reconstruction of addition in YBC 04224. In this table the suggested added balance is meant to represent how the extant total was achieved, while the expected added balance is meant to represent how the expected total would have been achieved had everything been added correctly. Several mistakes occurred as the author translated and transferred values between columns in lower addition, such as 30 *še* to one-6th *gin*. This can be compared to the upper addition, where only one mistake occurred when calculating within the column, as 5 *mana*

Table 6.16 Addition in two parts as shown in YBC 04224

Line		Whole *gu*	Whole *mana*	Fraction of *mana*	Fraction of *mana*	Whole *gin*	Fraction of *gin*	Whole *še*
39			38 *mana*	2/3 *mana*		2 *gin*	5/6 *gin*	18 *še*
41			5 *mana*	1/2 *mana*				
	Hypothetical extra addition		5 *mana*					
44			30 *mana*	2/3 *mana*		2 *gin*	2/3 *gin*	15 *še*
47			1 *mana*	2/3 *mana*				
52			20 *mana*			15 *gin*		
35–36	Suggested added balance	1 *gu*	41 *mana*	1/2 *mana*		19 *gin*	1/3 *gin*	⌜3⌝*še*
	Expected added balance	1 *gu*	**36 *mana***	1/2 *mana*	**1/3 *mana***		**2/3 *gin***	⌜3⌝*še*

Extant total: 1 *gu* 41 1/2 *mana* + 19 1/3 *gin* 3 *še* = 1 *gu* 41 2/3 *mana* 9 1/3 *gin* 3 *še*

Expected total: 1 *gu* **36** 1/2 *mana* + **1/3 *mana* 2/3 *gin*** 3 *še* = 1 *gu* **36 5/6 *mana* 2/3 *gin*** 3 *še*

was added twice. In the lower-level addition, the author had difficulty carrying between columns when the system deviated from a sexagesimal structure. With upper level addition it was much easier because the entire structure was sexagesimal.

The counting device itself could be set up differently based on the needs of the actor carrying out the calculation. However, as Proust (2000: 302) points out for Mesopotamian abaci, little was needed other than a flat surface to draw dividing lines on and some kind of counter—simply drawing on sand and using pebbles would have worked. Netz, discussing Greek abaci, goes even further. Speaking of counters in relation to the abacus, Netz (2002: 329) states:

> Counters were not some aid to the manipulation of number, itself understood primarily in other terms. They were the medium of numerical manipulation par excellence, in exactly the same way in which, for us, Arabic numerals are the numerical medium par excellence. We imagine numbers as an entity seen on the page; the Greeks imagined them as an entity grasped between the thumb and the finger.

To Netz, calculation was imagined as counters on an abacus just as we, the modern observer, see numbers as numbers on a piece of paper. In any event, it seems likely that an abacus used to add together measurement values existed in the kingdom of Larsa and that it was envisioned similarly to—if not in the same form of—the abacus described by Proust for SPVN. If so, and if it had the same lifespan as the abacus described by Proust, then one can suggest that it persisted as long as cuneiform culture existed as a mode for communicating economic transactions.

In this chapter, addition was carried out using measurement values, while in Chap. 5, both SPVN and partial-SPVN numbers found in texts were each transformed from initial measurement values. Where did these measurement values come from? Were they measured values or the result of a calculation? The next chapters will explore these questions, first discussing evidence for measurement values as well as values derived from calculation. Chapter 6 focused on discrepancies derived from mistakes and what this tells us of basic addition. The remaining chapters will explore error derived from observation and then estimation.

Chapter 7
Observation and the Limits of Numeracy

Abstract This chapter explores measurement practices in the kingdom of Larsa in order to examine whether the scribes who accounted for these measurements were aware of discrepancies inherent in their measurements, as well as how they understood and used their own measurement values. While mathematical texts like YBC 04669 show measurements were based on one uniform system of standards, the standards themselves showed microcultural and cultural variations between and within centers of the kingdom of Larsa. The measurement tools themselves were inconsistent. However, microcultural and cultural variations had to be transcended if goods were to move freely, so three different means to assess and then convert value between standards are shown: full remeasurement, sample measurements and change rate calculations and finally value estimates, including calculations of conversion rates. Examining full remeasurement in particular, it is shown that the scribes were probably aware of observational error and developed methods to cope with it, including truncating smaller values. Exploring possible reasons why truncation was acceptable, it is found that the metrological lists served to produce acceptable values, just as the numerical tables produced standard building blocks to calculate with sexagesimal place value notation, while deviation from these lists proved difficult at best.

Measurement as a means to observe and assess value must have played a key role in administering the Old Babylonian kingdom of Larsa. The statements of values found in the texts discussed so far were ostensibly derived at some point from observations of measurements. However, the texts seldom state that a measurement was taken. Measurement is often only implied. Yet terms do imply an assessment of value, terms like *šadādum*, Akkadian for 'to measure, survey', which is used to describe the physical surveying of land in Ashm 1923-340: 2. In addition, i$_3$-ag$_2$-e, 'he will measure out', is used to denote the future measurement of grain in capacity in A.26371: 9. Finally, i$_3$-la$_2$-e is used to state the future weighing of silver in HE 111: 28 and YBC 07787: 12. All three words are used to describe the assessment of value, whether such an assessment was observed or would be observed. In other words, measurements did take place.

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With each measurement comes an inherent error, today as in the ancient world. With each measurement, there is an 'uncertainty of measurement', the 'parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used' (VIM 54). Indeed, a 'true quantity value' or true value here, that is a 'quantity value consistent with the definition of quantity', is unique and unknowable (VIM 46). These errors which occur in initial data collection, appearing with and within the very measurements themselves, can be described as observational errors and are calibrated for today in modern experimental science. 'Precision'—or 'closeness of agreement between indications or measured quantity values obtained by replicate measurements on the same or similar objects under specified conditions' (VIM 48)—is important here, as is 'accuracy'—or 'closeness of agreement between a measured quantity value and a true quantity value of a measurand' (VIM 21). All of these terms are used to qualify observation in scientific and even modern professional environments. While modern scientists and professional practitioners may have their own definitions for observational errors, it must be asked whether the ancient actors who ran the Old Babylonian economy, the scribes, bureaucrats and merchants, had an understanding of this kind of error in observation.

The word 'observation' needs to be addressed at this point. While the act of measurement is certainly performative, it is the results of the measurement that are examined in this volume, that is, the observation and oversight of these acts represented by accounting practices. While it is tempting to focus on the performative aspect of measurement, it is also dangerous to do so in the context provided here. Seldom can we, as modern researchers, state with any certainty that the person recording or commissioning a measurement actually participated in the activity of measurement, and did not simply observe the measurement process, or even record it as a secondhand observation. We do note, however, that every measurement required an observation, otherwise the performance of the measurement would have been meaningless, and it is this observation of the performance that is recorded in most institutional accounts, not the performance itself. The phrase 'sag il$_2$-la-bi' in YBC 04224 lines 10 and 25 is instructive here. It is translated here as '(difference) when assessed' and is then followed by a measurement value quantifying silver by weight in line 10 and grain by capacity in line 25. The phrase itself refers to an act of reassessing value but does not describe this act itself, only the result of the act. It is employed to qualify a measurement value stated on an account. In other words, it is an observation of a measurement and not the measurement itself.

This means that if the term 'observation' is limited to observations of an instrument as a mediator in measurement alone, it cannot be applied here. However, if it can be understood as the observation of both instrument and performance as stated in a text, then it can be applied here. Thus, the term 'observation' is applied here, while any comment made on the performance is from the record-keeping perspective in which observation of the performance is made along with the results of the performance and cannot be mistaken for the performance itself.

7.1 Breakdown of Trust and the Practice of Oversight

The questions asked above can be partially answered by looking first at why assessments took place, within and outside of the Old Babylonian kingdom of Larsa. As noted by Johnstone describing Classical Greece, transactions often took place without actual measurement—trust played a key role in exchange in this society. In most instances, both personal trust and experience were important. Johnstone (2011: 36) states, 'with grain, they had to develop through experience a sense of how good any batch was and how much might be in any *phormos*, a kind of estimating or eyeballing that particularized every transaction'. Estimation by means of observation is important in this synopsis. Indeed, in the Classical Greek world, written documents were only a means to supplement trust between merchants, not a means to replace it (*ibid*.: 39), while customary units like the *phormos* mentioned in the quote above from Johnstone were used instead of standard units (*ibid*.: 35).[1]

However, two instances did require measurement because these systems of trust broke down: retail trade in the *agora* and delegation of authority in the Greek polis (*ibid.*: 49). With regard to the former, it is difficult to compare retail trade in the kingdom of Larsa with that of the Classical Greek polis because coinage did not exist yet in the bronze-age Near East and so both seller and purchaser were on an equal footing in relation to expertise.[2] Concerning interactions with the *polis*, Johnstone (*ibid.*: 53) states that, because measurement was costly and protracted,

[1]While unprovable, a similar situation can be hypothesized in the kingdom of Larsa, where personal experience and trust were important to typical transactions while measurements themselves were rare. In this hypothesis, the average person in a marketplace would not rely on official temple or royal standards, but on measures common in the marketplace. The purchaser would evaluate an item's worth based on experience and would barter with the seller. The method of payment would be customary as well. A *sila* measurement, for instance, would be the cup used by the merchant and not necessarily calibrated to local standards. Such a *sila* would, instead, be agreed upon by both parties at the time of purchase. If this is the case, then most transactions would be undocumented while most assessments of value would be based on custom and experience. Moreover, in most of these situations, it can be hypothesized that both seller and buyer were part of the same community, which means trust would play a significant factor in the sale. However, trust might break down when dealing with outsiders from a community, in which case there could be recourse to local standards.

[2]See Johnstone (2011: 53–55) for this. Much of Johnstone's arguments on measurement in the retail trade relies on an imbalance created by the introduction of coinage, which set the buyer at a disadvantage: the seller could know the value of coinage in advance of purchase while the buyer could not know the quality of the purchased item before the transaction was completed. Such an imbalance was partially alleviated by measuring the purchased commodity with some form of standard. 'The political imposition of standard measures on trade can thus be seen as an attempt to endow buyers with advantage similar to those of sellers' (*ibid.*: 54). Moreover, trade without standards probably did occur outside of the *agora* (*ibid.*: 54).

officials only measured when required to by law and because they were obliged to submit accounts at the end of a term.[3]

Accountability is certainly a priority in the bureaus and archives examined here. As shown in Chap. 3, economic texts in Mesopotamia during the Ur III period and probably the Old Babylonian period as well, were produced to maintain accountability and responsibility, while reporting already obtained numerical data to a higher authority. Moreover, Chap. 4 showed that the boundaries between institutional and private authorities were blurred, so that most of the actors in this study were interacting with some form or bureaucracy in which authority and responsibility were delegated and record-keeping systems were put in place to maintain accountability.

The texts themselves show the need for supervision. They display an awareness that value may not be what is expected and so an authority was needed to assess value and limit bureaucratic culpability. Thus, there are several terms used to denote the reassessment of value. *sanāqum*, 'to check weight,' denotes a form of oversight in Ashm 1922-336, line 4, probably the physical remeasuring of a quantity or portion of a quantity by interested parties or a certifying authority.[4] sag-bi$_2$ la$_2$ is employed to denote that a measured value in LB 1075 line 3 is verified by an unstated authority. As stated above, sag il$_2$-la-bi implies the physical reassessment of value after receipt of goods by a certifying authority.[5] In YBC 04224, lines 10 and 25, this term seems to suggest a difference between a subtotal set of values, which resulted from physical measurements by scribes, and then a total of values expected by the scribe.

Each of these words describes simple supervision of goods—they verify value. They could, for instance, refer to sample measurements and then adjustment of the

[3]Indeed, in Hellenistic Egypt, where large estates limited the utility of trust relationships, authority had to be extensively delegated. This required that mechanisms to assure accountability were put in place to offset lack of trust. Concerning grain shipment, Johnston notes five methods to produce this accountability: exact grain measurements, standardization, sealed product samples for reassessment upon arrival, armed guards and copious documentation.

[4]The verb *sanāqum* implies arrival at, or movement toward, a position or place (CAD S: 133–138 definitions 1–3 and Black et al. 2000: 315–316) and, as far as measurements are concerned, is translated as '"check" that something is correct, weight, amount…', as well as 'to supervise, control, to execute exactly, reliably' (*ibid.*: 315–316). Thus, in this nuance it is understood as a form of supervision or management which improves reliability and confidence in a measurement.

[5]sag il$_2$, Akkadian *rēšum našûm*, is translated in CAD (N 2: 107) as 'a) to check on quality or quantity of fields, stables, animals'. Veenhof (1985: 298) notes the 'Akkadian parallel makes an idiomatic interpretation of sag-íl-la, without regard to the use and meaning of sag in Ur III texts, the more likely solution, hence "(result of) an assessment", "quantity/number assessed", "difference assessed"'. Veenhof (*ibid.*: 293) defined assessment as the result of a calculation when goods are assessed twice, often by means of two separate standards, although 'depending on the context and the measure taken as standard, this implies either an increase, an addition, or a reduction compared with the capital which is the point of departure'.

total quantity based on the measurement.[6] On the other hand, a complete remeasuring could have been carried out by an official as well.[7] For the purposes of this volume, remeasurement could imply sample measurement and then adjustment as well as complete remeasurement. This is because in both instances a second measurement was certainly made—the difference is the scale of remeasurement. When possible, the remeasurement's nature is hypothesized.

These words describe a remeasurement; they do not necessarily show the scribes were aware of the potential discrepancy inherent in using measuring instruments either. They only show that the scribes were aware that some discrepancy might exist between expected and current value. This discrepancy could result from a number of causes: fraud, incompetence, theft or the uncertainty of a measurement. Were the bureaucrats who accounted for these measurements and who carried out this supervision aware of discrepancies inherent within their system of assessment? Indeed, were these ancient scribes aware of the effects the measured values had on their work and lives? Were they aware of the nature of discrepancies and did they develop means to cope with these discrepancies? What influenced their means of coping?

7.1.1 The Uniformity of Measurements and Measurement Values

To answer these questions, it will help to explore the tools for assessing value as well as how value was assessed. To start with, how uniform were the tools the scribes and bureaucrats used to assess value? Chapter 2 showed that while there were superficial differences in the early scribal education, the metrological and numerical systems they presented were certainly the same throughout the kingdom of Larsa. This suggests uniformity, at least in how measurement values were conceived. Microcultures only existed in the expression of this system. Thus, the metrological lists learned in this education produced a framework for the scribe in which measurement values were placed within metrological systems, with larger and smaller values corresponding to different measurement units within each

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[6]Such as those when grain was shipped in Hellenistic Egypt as described by Johnstone (2011: 58). In his reconstruction, Johnstone shows that grain shipments were often accompanied by samples under seal, which were employed to deter qualitative adulteration of the shipped grain during transit. This sealed sample would be assessed for quality and quantity upon arrival. Any discrepancies would need to be accounted for by adjusting the stated quantity under shipment to the change in the quantity assessed. In an example cited by Johnstone (*ibid.*), the quality declared was not the quality in the sample so that, once the sample was assessed, the entire shipment needed adjustment to this quality.

[7]This would be similar to the measurement of delivered quantities by a professional as described by Johnstone (2011: 49–50). However, as shown by Johnstone (*ibid.*: 49), assessment by measurement was expensive and time-consuming.

Table 7.1 Capacity measures in YBC 04669 by problem

Problem	Name	Transversal	Height	Capacity
1	^{giš}ba-ri$_2$-ga	2/3 *kuš* 4 *šusi*	2/3 *kuš* 2 1/2 *šusi*	1 *bariga*
2	^{giš}ba-an 3(ban$_2$)	1/2 *kuš* 3 *šusi*	2/3 *kuš*	3 *ban*
3	^{giš}ba-an	1/3 *kuš* 2 *šusi*	1/2 *kuš*	1 *ban*
4	^{giš}nig$_2$ 1(diš) sila$_3$	6 *šusi*	6 *šusi*	1 *sila*
5	^{giš}nig$_2$ 1/2 sila$_3$	4 1/2 *šusi*	5 1/3 *šusi*	1/2 *sila*
6	^{giš}nig$_2$ 1/3 sila$_3$	4 *šusi*	4 1/2 *šusi*	1/3 *sila*
7	^{giš}nig$_2$ 1(u) gin$_2$	3 *šusi*	4 *šusi*	10 *gin*
8	^{giš}nig$_2$ 5(diš) gin$_2$	2 *šusi*	4 1/2 *šusi*	5 *gin*
9	^{giš}nig$_2$ 1(diš) gin$_2$	1 *šusi*	3 1/2 *šusi*[a]	1 *gin*

[a]As Proust notes, we expect 3 1/2 + 2/5 *šu-si*

system. The relationships exhibited in the metrological lists and tables are reinforced by several mathematical texts, which reveal the sizes of standard measurement values. For instance, YBC 04669, problems one through nine, presents the parameters for nine grain measures corresponding to 1 *gin*, 5 *gin*, 10 *gin*, 1/3 *sila*, 1/2 *sila*, 1 *sila*, 1 *ban*, 3 *ban* and 1 *bariga* (Table 7.1).

The listed names of each measure are translated by Proust (forthcoming) as 'standard vessel'. Thus, there is a *bariga* standard vessel, *ban* standard vessel, *sila* standard vessel and *gin* standard vessel in YBC 04669. Proust, building on the lexical tradition, shows similarities between this text's entries and the lexical list for trees and woods found at Nippur (lines 516–526), and then similar lexical texts from Ur (Proust forthcoming: Fig. 8). As she notes, the texts from Ur are more complete than the sources from Nippur, although it is clear from her Fig. 8 that both centers present more variety than is presented in YBC 04669. This variety points to superficial differences in measurement vessels. Just as the lists and tables could vary superficially from center to center and still present the same metrological systems, the variety of standard vessels could vary from center to center. Thus, the microcultures proposed in Chap. 2 are also manifested in the standard vessels described in each center. While the lists and tables present the same metrological systems in different ways, this alone does not prove whether standard vessels were the same, so that it must be asked 'were there multiple standards to assess value'?

7.1.2 Standard Variation

YBC 04669 and similar texts show that standard measuring vessels were based on mathematical calculation which incorporated length and height measurement values. The lists and tables unified these values into one recognizable system. Mathematical training in measurement standards was important. As Veenhof (1985: 300) states:

> For the accountant it was important that the different measures by which goods had been delivered or disbursed were identified by the mention of their size, by reference to a particular standard, or by other designations. This happened regularly and some texts even stipulated in advance which measures had to be used.[8]

Size was important because it produced standard values for each measuring vessel. Moreover, Veenhof points to different measurement standards for each measuring vessel, so that it had to be stipulated which standard or vessel was to be used.

Veenhof's statement is witnessed in the texts presented here as well. The smallest standard vessel witnessed in the texts is the *ban*-standard vessel, listed as either ^{giš}ba-an in YBC 04224, line 42, and ^{giš}ba-an-1(ban$_2$) in YBC 04265, line 5. The 3 *ban*-standard vessel is also present, listed as ^{giš}ba-an-3(ban$_2$) and ^{gis}3(ban$_2$) in several exemplars, as well as the *bariga*-standard vessel described as ^{giš}ba-ri$_2$-ga.

Table 7.2 lists the various standard vessels encountered in pursuit of the current study by text in column I, standard vessel name in column II, any qualifiers in column III, the capacity measure it refers to in column IV, the date it appears in column V and the archive it belongs to if studied here in column VI. Interestingly, there are multiple methods for writing *ban*-standard vessel and 3 *ban*-standard vessel. A.26371, A.26378, YBC 04224, YBC 04470, YBC 04265 and YBC 07194 were probably all produced within the city of Larsa. Indeed, *Nabi-Šamaš*, *Šēp-Sîn* the merchant overseer of Larsa, *Ṣillī-Šamaš* of the grain storage bureau and the notable *Abu-waqar* were probably active within the city of Larsa. Moreover, the remainder of texts, aside from A.26378 for which provenance of the scribe, at least, is possibly at Ur, were probably produced in the city of Larsa as well, as part of the system described in Chaps. 3 and 4 of using merchant intermediaries to assess excess capital in silver on behalf of the crown. Thus, there was more than one method to express these standard vessels within the city of Larsa itself, dependent on the scribe who wrote the texts. Second, all standard vessels except *bariga*-standard vessel in YBC 07194 have some form of qualifier or statement used to distinguish one standard from another. These qualifiers are similar to weight qualifiers described by Powell (1971, 1973: 242–243):

> To the term "stone" could be added qualifying adjectives such as si-ša (Akkadian *išaru*?) "standard," gi-na (Akkadian *kittu*) "true," and mah (Akkadian *kabtu*?) "heavy." Weights were also qualified according to the objects they were intended to weigh, e.g. wool, according to their geographical origin, and according to the divine or human being whose standard was thus incorporated.

In Table 7.2, capacity standard vessels are qualified in several ways. First, they are qualified by words such as *kittum* and gi-na, both of which mean 'true'. They are also qualified by words like guru$_7$, 'granary', or ensi$_2$ e$_2$-gal, 'the palace farmer'. They are qualified by deities such as Šamaš and Marduk. Finally, standards are qualified by deviation from the original standard used to assess a commodity, such as 1(bariga) 6(diš) 2/3 sila$_3$ or 1(bariga) 4(diš) sila$_3$ (for which see below, Sect. 7.1.3).

[8]See also Sallaberger (forthcoming) for measuring containers in the Ur III period in particular.

Table 7.2 Capacity standard vessels by archive

I. Museum Number: line	Publication	II. Name	III. Qualifier	IV. Capacity	V. Date	VI. Scribe/ archive
YBC 04224: 42	Simmons 1979: no. 164	^{giš}ba-an	2(u)^{giš}ba-an 1 (u) na$_4$-lugal	1 *ban*	*Gungunum*	scribe A
YBC 04265: 5	Stol 1982: no. 29	^{giš}ba-an-1 (ban$_2$)		1 *ban*	*Hammu-rābi* 36	*Nabi-Šamaš* B
YBC 04277: 2	Stol 1982: no. 25	^{giš}ba-an-3 (ban$_2$)	^{d}Marduk	3 *ban*	*Hammu-rābi* 39	NA
A.26372: 35	Stol 1982: no. 34	^{giš}ba-an-3 (ban$_2$)	^{d}Marduk	3 *ban*	*Hammu-rābi* 41	NA
YBC 10586: 2	Stol 1982: no. 16	^{giš}ba-an-3 (ban$_2$)	^{d}Marduk	3 *ban*	*Hammu-rābi* 42	NA
YBC 04333: 8	Stol 1982: no. 31	^{giš}ba-an-3 (ban$_2$)	^{d}Šamaš	3 *ban*	*Hammu-rābi* 42	NA
YBC 04241: 2	Stol 1982: no. 12	^{giš}3(ban$_2$)	^{d}*ki-it-tum*	3 *ban*	*Hammu-rābi* 37	NA
A.26371: 3	Stol 1982: no. 37	^{giš}3(ban$_2$)	gi-na	3 *ban*	*Hammu-rābi* 40	*Šēp-Sîn* B
YBC 04244: 2	Stol 1982: no. 14	^{giš}3(ban$_2$)	^{d}Marduk	3 *ban*	*Hammu-rābi* 41	NA
YBC 06107: 4	Stol 1982: no. 15	^{giš}3(ban$_2$)	^{d}Marduk	3 *ban*	*Hammu-rābi* 42	NA
A.26380: 2	Stol 1982: no. 33	^{giš}3(ban$_2$)	^{d}Marduk	3 *ban*	*Hammu-rābi* 42	NA
YBC 08271: 2	Stol 1982: no. 18	^{giš}3(ban$_2$)	^{d}Marduk	3 *ban*	*Hammu-rābi* 43	NA
YBC 07194: 8	Breckwoldt 1995/1996: 87	^{giš}ba-ri-ga		1 *bariga*	*Rīm-Sîn* 6	*Ṣillī-Šamaš*
YBC 04265: 2	Stol 1982: no. 29	^{giš}ba-ri-ga	1(bariga) 6 (diš) 2/3 sila$_3$	1 *bariga*	*Hammu-rābi* 35	*Nabi-Šamaš* B
YBC 04470: 10, 13, 16	Stol 1982: no. 27	^{giš}ba-ri-ga	1(bariga) 4 (diš) sila$_3$	1 *bariga*	*Hammu-rābi* 41	*Abu-waqar*
A.26378: 2, 7	Stol 1982: no. 38	^{giš}ba-ri-ga	ensi$_2$ e$_2$-gal, 1 (bariga) 4(diš) sila$_3$	1 *bariga*	*Hammu-rābi* 41	*Ilīma-abī*
YBC 04288: 2	Stol 1982: no. 28	^{giš}ba-ri-ga	guru$_7$	1 *bariga*	*Hammu-rābi* 41	NA

There are also two main standards listed for weight measures in the texts here, both appearing early in the period studied: na_4-lugal, royal weight, in YBC 04224: 42, and na_4-dam-gar_3, merchant weight, in YBC 04224: 13, 37, 40, 45, 47, 49 and YBC 04761: 2, 6, 8, 11. Competing standards are witnessed in both weight and capacity systems. The use of standards suggests the need for a method to compare individual weights and measures because these individual weights and measures, which will be called personal standards here, might vary.

Weights appear in the archaeological record for Nippur, Ur and Larsa and are well suited for examining these personal standards. Speaking of weights from Nippur, in particular *gin* measures (translated as shekel), Hafford (2005: 367) states:

> It is certain that the range of the shekel varied at all times depending on the individual scales and sets of weights in use, and the tolerable variance in weighing practice likely ranged around 5%. The expected variance at any time, then, would be approximately 0.4 grams either side of the 'typical' Mesopotamian shekel, i.e., from 8.0-8.8 g. Such is clearly the range of 95% of all weights at Nippur and the few that are localized to the Old Babylonian period may simply be from the upper end of this range.

There is considerable variation within the city of Nippur throughout its history, although, as Hafford (*ibid.*: 366) points out, there is no evidence of temple standards in the Old Babylonian period due to the rebuilding of the temple in the Parthian period.

At Ur, however, there is archaeological evidence for weights dating to the Old Babylonian period. Peyronel (2000: 178) examines a collection of about sixty-two weights that were found in twelve graves dating to the Old Babylonian period:

> They are all in haematite, well polished and barrel or duck-shaped, and they can be considered as precious items, of special economic and symbolic value. Together with the cylinders, they are the most important and valuable objects found in the burials and should be regarded as personal effects used by the dead during their lifetimes in economic and commercial activities.

These weights exhibited a similar range of variation to that described by Hafford, while two balance pan sets were found in different graves. In grave LG/23, two copper or bronze balance pans were found along with four barrel-shaped weights, both round, slightly concave and about fifty centimeters in diameter. In addition, traces of a wood beam were found near them (*ibid.*: 181). The weights themselves reflected a *gin* weighing around 7.8 g with some discrepancy, between 0.4 and 6.7 per cent of the reference standard.

Table 7.3 sums up the weights from grave LG/23 as described by Peyronel, as well as each weight's discrepancy. The standards these weights referred to vary from 7.28 to 7.77 g, a 0.49 g difference. As Peyronel suggests, weights from tomb LG/23 reflect standards that are common to north-western central Syria at this time, not southern Mesopotamia. Interestingly, the weights themselves, if understood correctly, show a different computational culture as well. One-8th *gin*, which corresponds to 22 1/2 *še*, is not a standard measurement value as witnessed on any Old Babylonian list or table of weights, which suggests that citing a standard also cited the metrological system this standard represented.

Table 7.3 Syrian weights in grave LG/23 [For these weights, see Peyronel (2000: 179, Table 2)]

I. Ancient weight	II. Modern weight (g)	III. Expected *gin* standard (g)	IV. Reference *gin* standard (g)	V. Per cent difference (%)
One-8th *gin*	0.96	7.68	7.8	1.5
One-4th *gin*	1.82	7.28	7.8	6.7
1/3 *gin*	2.56	7.68	7.8	1.5
2/3*gin*	5.18	7.77	7.8	0.4

Grave LG/45 (Table 7.4), however, presented a different picture. A circular, disc-shaped copper balance pan was found with twelve barrel-shaped weights (*ibid.*: 182). Discrepancy here is between less than one per cent to 6.7 per cent while the *gin* these weights referred to varied from 7.96 to 8.96 g—a 1 g difference. These weights, which reflect a *gin* of around 8.4 g, are described as Mesopotamian weights by Peyronel and, if they are correctly identified, by and large they bear witness to the metrological system as seen in the kingdom of Larsa and described in Chap. 2. Interestingly, the *gin* and double *gin* appear three times each in this grave. As Peyronel (*ibid.*: 184) points out, a single and double *gin* are the most commonly referred to reference standard for weight so that their appearance may point to their importance as a standard. Summarizing this evidence, Peyronel (*ibid.*: 183) states, 'the presence of scale-pans in the two graves testifies to the relationship of the weights within a given metrological system; in other words it seems very probable that the specimens belong to balance-sets as multiples or subdivisions in a coherent series related to standard values'. Two different standards for the *gin* reflecting two different cultures within one city show that standard variation was not just an interregional issue, it could be a local issue as well.

The weights of grave LG/45 especially show that the size of the weight does not affect the potential to produce a discrepancy. In Table 7.4, 1/3 *gin*, 2/3 *gin* and 2 *gin* weights all had discrepancies at or greater than five per cent between expected and stated weights, while the smallest weight of 25 *še* had only a 1.4 per cent difference between expected and actual weight and two 2 *gin* weights had a less than one per cent difference between expected and actual weight.

Within the city of Larsa itself, weights found in an Old Babylonian goldsmith's workshop at the Ebabbar temple, ostensibly based on or calibrated for the temple standard, were studied by Arnaud et al. (1979) and then returned to by Peyronel (2000). Arnaud et al. (1979: 24–34) use both one-6th and half *gin* weights as evidence that measurement practices may have differed between scribes and professional practitioners. Peyronel (2000: 184, esp. n. 24) points out that some weights in this workshop centered around the Syrian *gin,* suggesting that standards could differ, not just within a city, but within an institution. However, it can equally

Table 7.4 Mesopotamian weights in grave LG/45 [For these weights, see Peyronel (2000: 179, Table 2)]

I. Ancient weight	II. Modern weight	III. Expected *gin* standard	IV. Reference *gin* standard (g)	V. Per cent difference (%)
25 *še*[a]	1.15 g	8.28 g	8.4	1.4
1/3 *gin*	2.94 g	8.82 g	8.4	5
1/2 *gin*	4.03	8.06 g	8.4	4
2/3 *gin*	5.31	7.96 g	8.4	5.2
2/3 *gin*	5.76	8.64 g	8.4	2.9
1 *gin*	8.19	8.19	8.4	2.5
1 *gin*	8.51	8.51	8.4	1.3
1 *gin*	8.62	8.62	8.4	2.6
2 *gin*	16.64	8.32	8.4	<1
2 *gin*	16.64	8.32	8.4	<1
2 *gin*	17.92	8.96	8.4	6.7
3 *gin*	25.60	8,53	8.4	1.5

[a]Peyronel states this weight would be 1/7 *gin*, which hardly seems possible if it is an Old Babylonian Mesopotamian weight because this did not exist on the standard metrological tables. It would have to be either 25 or 26 *še*. Here it is assumed to represent 25 *še*, which brings the weight itself closer to the reference of 8.4 g per *gin*

be noted that each weight itself presented the same inconsistency between standard and weight as is exhibited at both Nippur and Old Babylonian Ur.[9]

Discussing the weights from Larsa and weighing practices in general, Arnaud et al. (1979: 33) state:

> Les variations autour des deux *unit* A et B expriment en même temps la limite de précision que les techniques antiques de fabrication pouvaient atteindre, la sensibilité des balances utilisées, antiques mais ajoutons contemporaine (sic), et bien sûr, l'erreur de l'étalon de référence.

The weight itself, as well as the scale, limited how exact a measurement could be. From all of this, we can suggest that weights based on standards varied in the kingdom of Larsa, regardless of the culture these standards referred to, the size of the weight, or proximity to a reference standard. Indeed, in both Larsa and Ur, two competing standards were present, reflecting cultures common in southern Mesopotamia and in north-west central Syria. Citing a standard, then, provided the relative size of a measurement compared to other standards as well as the metrological system behind these standards.

This is not limited to the Old Babylonian kingdom of Larsa. Both Michel (forthcoming) and Joannès (1989: 125) show different weight standards for the Old Assyrian merchant colonies and the kingdom of Mari far to the north of Larsa. First, both Michel and Joannès describe a twin balance pan similar to that found with the

[9]Cf. Arnaud (1976: 28–30) for these weights' descriptions, including weight assessed in grams.

Syrian weights in grave LG/23 used as a scale to assess weight (*ibid.*). With the Old Assyrian merchants, as Michel notes individual merchants, town authorities, etc., owned and used their own weights to assess goods. Merchants would use their own weights and simply calibrate their weights based on local standards so that they understood deviation inherent in their personal weights compared to local systems. The merchants had to be adept at calibrating weight to local standards because they crossed between two very distinct standards, their own merchant colony's standard on the one hand and each Anatolian standard on the other. Michel also notes a deviation in *mana* standard weights from 0.83 to 2.1 per cent (for this, cf. Michel forthcoming: esp. Table 6). Here, it is the merchants who are weighing and assessing goods and who are thus familiar with how to work with competing standards.

Joannès (1989: 128) notes a distinction between the individuals weighing goods in the palace hierarchy and the scribes who are recording weighing. This is in contrast to the Old Assyrian merchants who both weigh goods and record these weights. Perhaps this points to a difference in bureaucratic interest. Merchants serve their own interests, whether they act independently or are part of a firm. Thus, they need to be adept at measurements to be able to affirm value at the least. Palace bureaucrats act as part of a hierarchy and so the scribe active in a palace may not be the person assessing value. Indeed, at Larsa, if Arnaud's assessment is followed, the temple goldsmith is weighing for himself, not some bureaucrat.

7.1.3 Changing Standards and Value Assessments

Measurement standards, indeed, it seems that all weights, measures and, in some instances, the metrological systems they referred to, varied. How, then, did the ancient scribes and bureaucrats work with and across these standards? To start with, it will help to understand measurement practices themselves. Equilibrium is important early at Larsa, where the enigmatic qualifier '2(u) $^{\text{giš}}$ba-an 1(u) na$_4$-lugal' is stated in YBC 04224 line 42. This may be an early Old Babylonian period method to state a conversion by full measurement between two standards. Conversion is used here to denote a mathematical process of movement between metrological standards. Within the kingdom of Larsa, this often implied the assessment of value using the same metrological system, but which was expressed in a different microcultural setting. Conversion is different from the word 'translation', which only states a numerical or metrological change in expression, because a conversion denotes a change in the numerical value while the expression of this value, that is the system of quantification, will stay the same. Conversion in YBC 04224 line 42 uses system S to count both *ban*-standard vessels, that is, the objects used as a standard *ban*, and the weight set by the king, that is objects serving as royal standards (na$_4$-lugal). As Sallaberger (forthcoming) notes, in the Ur III period a means to assess grain was to count measuring containers as well. This may be what is described in

YBC 04224: line 42. Thus, each measure is measured out and the total count is stated. The standard itself is listed as a difference in count between the two.

A different process may be suggested with the appearance of sag il_2-la-bi in YBC 04224. In line 10 this term qualifies silver while in line 25 it qualifies sesame. This is probably not the same process as suggested by line 41 because the terminology is different and no specific standards are mentioned. Values stated in lines 9 and 24 respectively were probably not literally remeasured. Above, it was stated that a remeasurement could refer to a sample measurement. In this case, a sample of a commodity would be measured and then the entire measured value adjusted, based on the difference between the original measurement and the remeasurement of the sample.

If, for instance, a load of sesame were packed into standardized containers such as sacks at a customary rate, say 1 *gur* per sack, then perhaps the author measured one sample container to produce a coefficient that reflected the difference between the value of the container's original assessment and the new assessment. This coefficient will be referred to here as the 'change rate'. The assessor would multiply the originally assessed value by the change rate to produce the value to be added to the old total value. This would be the '(difference) when assessed'. The same could be said for silver: if silver were in customary lots, say a 1 *gin* or *mana* ingot, then an official would only weigh one sample ingot, produce a change rate to multiply against all the ingots in order to produce the total '(difference) when assessed'. This is possibly what is happening when the phrase 'sag il_2-la-bi' is used—it refers to the difference produced by a sample measurement and subsequent change rate.

This is also probably what is happening with sag-bi_2 la_2 in line 3 of LB 1075, produced by *Sîn-iddinam* in *Rīm-Sîn* of Larsa's thirty-ninth year in power. In this tabular balanced account, 5 *gur* 4 *bariga* 2 *ban* salt appears in line 2 as capital. In line 3, another value, 3 *bariga* 2 *ban* 5, is qualified by the word, 'sag-bi_2 la_2' as well as a rate of 3 *ban* 5 *sila* per 1 *gur*. This suggests that this rate is a change rate and that sag-bi_2 la_2 refers to a sample measurement. If so, then this tells us how these rates were computed. 1 *gur* of salt was remeasured and was found to be 3 *ban* 5 *sila* larger than the local or personal standard used by the measuring authority. This was probably multiplied by the entire capital assessment. The value this produced was added to the total. This process probably worked as follows: First, it is suggested the author transformed all values to SPVN in preparation of calculation:

5 *gur* 4 *bariga* 2 *ban* → *29:20* (Table of capacity)
1 *gur* → *5* (Table of capacity)
3 *ban* 5 (*sila*) → *35* (Table of capacity)

The reciprocal of 5, which corresponds to 1 *gur* in the change statement in row 3, is found, 12, and multiplied by 35, corresponding to 3 *ban* 5 *sila*, to produce the change rate of 7:

The reciprocal of *5* is $\underline{12}$
$\underline{12} \times 35 = 7$

7 is then multiplied by the measured value, 5 *gur* 4 *bariga* 2 *ban*, which transformed to 29:20, to produce the increase, 3:25:20, which transformed into 3 *bariga* 2 *ban* 5 1/3 *sila*. In the text, 1/3 *sila* is truncated from the total. Interestingly, granularity in this text is limited to *sila* measurement values; no parts of *sila* are mentioned. Two reasons for this can be posited. First, the author was possibly using an abacus as described in Chap. 6. Truncation in this hypothesis is based on the layout and limitations of a calculation instrument. However, the author also only measured to *sila* even if he could measure to *gin* and perhaps *še*, suggesting he may have truncated the assessment of the sample as well. Thus, it can be suggested that the author truncated measurement before multiplication and then truncated the product of multiplication. The author then added this new value to the original salt capital to produce the new total.

Note that 'the reciprocal of 5 is 12' is found on the reciprocal pair list of Nippur and possibly Ur, while 12 and 7 were standard head numbers for multiplication tables found at Nippur and perhaps common throughout the kingdom of Larsa. The author seems to have constructed the rate using building blocks learned in the scribal curriculum. Moreover, truncating a measurement value before calculation, if it took place, had the effect of simplifying calculation as well: the numbers 30 and 5, corresponding to 3 *ban* and 5 *sila* respectively, both appear as head numbers for typical multiplication tables as well. 30 and 5 were also entries in every extant multiplication table. Thus, the scribe only needed three numerical tables to carry out this calculation: the reciprocal pair table and the multiplication tables of 12 and 7. Truncation after measurement simplified calculation by change rate.

A similar process may occur in YBC 07194 line 8 where the phrase '9(aš) 2 (bariga) gur *ru-ub-bu-u*$_2$ *ša* $^{\text{giš}}$ba-ri$_2$-ga', '9 *gur* 2 *bariga* the increase of the *bariga*-standard vessel' appears. '*ru-ub-bu-u*$_2$ *ša* $^{\text{giš}}$ba-ri$_2$-ga' possibly qualifies 9 *gur* 2 *bariga* as a reassessment due to a standard change. The measurement value 9 *gur* 2 *bariga* is added to the total delivery, similar to the additions made with sag il$_2$-la-bi in YBC 04224 as well as sag-bi$_2$ la$_2$ in LB 1075. Thus, a similar process can be suggested: The scribe produced a change rate by a sample measure and multiplied this rate by the original assessed value, at which point a 9 *gur* 2 *bariga* difference was found between the two standards and listed apart from the delivery and from the disbursements in the text. To limit culpability, the scribe noted the reason for this addition, 'the increase of the *bariga*-standard vessel'. The increase here probably refers to larger standards at shipment than at delivery. This is because it is added to the amount delivered and disbursed and thus ultimately subtracted from the original measurement value at shipment.

A different technique appears during the reign of *Hammu-rābi*. '1(bariga) 4(diš) sila$_3$' qualifies the *bariga* standard vessel in YBC 04470 attributed to *Abu-waqar* and in A.26378 attributed to *Ilīma-abī*, while '1(bariga) 6(diš) 2/3 sila$_3$' qualifies the *bariga* standard vessel in YBC 04265 attributed to *Nabi-Šamaš* B. In the two former cases, each *bariga* standard vessel at delivery is 4 *sila* larger than at disbursement, while in the latter, the *bariga* standard vessel at delivery is 6 2/3 *sila* larger than at disbursement. Indeed, YBC 04265 lines 2 through 4 seems to qualify this twice.

Table 7.5 Proposed standard conversion calculation in YBC 04265

<table>
<tr><td>1</td><td>1(geš$_2$) 4(u) 5(aš) gur še</td><td>1×60+45 gur grain</td></tr>
<tr><td>2</td><td>$^{\text{giš}}$ba-ri$_2$-ga</td><td>bariga-standard vessel (is)</td></tr>
<tr><td>3</td><td>1(bariga) 6(diš) 2/3 sila$_3$</td><td>1 bariga 6 2/3 sila</td></tr>
<tr><td>4</td><td>ša i-na 1(aš) gur, 3(ban$_2$) 3(diš) ⸢1/3 sila$_3$⸣</td><td>which from 1 gur, 3 ban 3 1/3 sila</td></tr>
<tr><td>5</td><td>a-na $^{\text{giš}}$ba-an-1(ban$_2$)⸢x x⸣</td><td>at the 1 ban-standard vessel x x</td></tr>
<tr><td>6</td><td>tu-ur-ma</td><td>returns and</td></tr>
<tr><td>7</td><td>1(geš$_2$) 5(u) ⸢6(aš)$^{\text{sic}}$ 3(bariga)⸣ 2(ban$_2$) gur še</td><td>1×60+56$^{\text{sic}}$ gur 3 bariga 2 ban grain</td></tr>
<tr><td colspan="3">Original in-grain value 1
1×60+45 gur → 8:45 (table of capacity)
Conversion rate 1 (disbursement)
1 bariga 6 2/3 sila → 1:6:40 (table of capacity)
When 8:45, the SPVN equivalent of total gur in line 1, is multiplied by the stated bariga conversion rate in lines 2-3, the following is seen:
8:45 × 1:6:40 = 9:43:20
Converted in-grain value
9:43:20 → 1×60+56 gur 3 bariga 2 ban (table of capacity)</td></tr>
</table>

These lines state that the *bariga* vessel at delivery is 1 *bariga* 6 2/3 *sila* at disbursement, so that every 1 *gur* to be delivered is raised by 3 *ban* 3 1/3 *sila* at the 1 *ban*-standard vessel during disbursement. In line 7 the author converts the delivery value stated in line 1, 1 × 60 + 45 *gur*, into 1 × 60 + 56 *gur* 3 *bariga* 2 *ban* delivery value using these stated rates.[10] Thus, YBC 04265 presents a completed conversion estimate, not simply the rate, and so it is possible to state that calculation was carried out by means of a multiplication (Table 7.5).

The conversion rate, when transformed into SPVN, amounts to the SPVN number 1:6:40. This number can be partitioned into the numbers 1 and 6:40. A multiplication table for 6:40 existed, while each head number on the multiplication tables was multiplied by 1, making calculation by this rate very simple. If calculation was carried out using SPVN numbers transformed from measurement values found on the metrological tables, then the conversion rate is made up of basic components that were defined by the numerical tables learned in the elementary phase of scribal education, similar to the conformity witnessed in Chap. 5.

However, the author of YBC 04265 felt the need to qualify this rate. In line 4 he states '*ša i-na* 1(aš) gur 3(ban$_2$) 3(diš) 1/3 sila$_3$', which translates to 'which from 1 *gur*, 3 *ban* 3 1/3 *sila*'. This is similar to the change rate construction in LB 1075:

1 *gur* → *5* (table of capacity)
3 *ban* 3 1/3 *sila* → *33:20* (table of capacity)

The reciprocal of *5* is $\underline{12}$
$\underline{12}$ × *33:20* = *6:40*

[10]This standard conversion, adding 33 1/3 *sila* to each *gur*, is already suggested by Veenhof, who further states that conversion is 'expressed by *târum*, D-stem stative, 'to turn into' (Veenhof 1985: 302).

12, the reciprocal of the measured sample, is multiplied by 33:20, the change statement, to produce 6:40, which transforms into 6 2/3 *sila*. 6:40 was then appended to 1 *bariga* to produce the conversion rate of the new *bariga* standard, 1 *bariga* 6 2/3 *sila*. Thus, the bariga standard vessel used to define the conversion rate is produced out of a sample measurement and change rate. This means that the calculation could have been carried out in the same manner as LB 1075, where 6:40 was multiplied by the initial assessed value to produce the total change with the new standard, which was then added to the initial assessed value to produce the new value. It could also have been carried out as outlined above. The latter is followed here because there is no description of a total change, only the new total. Moreover, the advantage of a conversion rate over the calculation just described is that the author need not perform an extra addition or subtraction. The calculation is, however, based on the relationship with a *gur*, which would have been the amount measured here.

YBC 04265 helps to prove that the change rate is produced out of a sample measurement and is not simply a customary rate. The amount measured is stated, 1 *gur*—perhaps a reference to a container size used to ship grain, a sack of 1 *gur* capacity. This *gur*-sized sack may have been chosen because it was the amount a man could carry in one trip, although this is mere conjecture. In any event, a reference standard used to assess this *gur* sample amount is also stated in line 5, the 1 *ban* standard vessel. Thus, this was a sample measurement made using a standard vessel that was used to compute conversion. Sample remeasurement took place, but it was to carry out a conversion, not to verify value.

Abu-waqar with YBC 04470 and *Ilīma-abī* with A.26378 describe a conversion rate of '1(bariga) 4(diš) $sila_3$' which transformed to 1:4 in SPVN. No change rate is specified in these instances so that it is unlikely that a sample measurement was made in pursuit of these conversions. Thus, unlike YBC 04265, these conversion rates were more likely agreed upon by the parties involved in the transactions. That is to say, they were customary, recognized conversion rates that did not require sample measurement. Conformity in these rates may have been based on multiplication tables present in the elementary phase of the scribal curriculum to facilitate easy conversion between standards.

All three texts take on the form of contracts and are certificates used to limit liability. They stipulate an amount of grain and then a conversion rate and, in the case of YBC 04265, the change rate produced from a sample measurement. These texts each present an estimation of value that may not have represented a physical reality, but instead state an expected reality, just as was seen with conformed equivalency rates in Chap. 5. The actors in all three texts were working between two standards and wanted a statement in writing that the amount shipped was already converted to the standard vessel at delivery and was witnessed by multiple actors so that neither party could take advantage of the other by using a small standard when the larger standard was expected, or vice versa, nor could one claim

at delivery that the other had measured improperly at disbursement. If remeasurement took place upon delivery and value deviated, the sender's liability was obviated by stating the rate as well as the witnesses who confirmed that measurement at disbursement was made properly. These documents stipulate the standard just as Veenhof describes in his quote above (Sect. 7.1.2), but in a manner that is easy to compute by each party and then witnessed by third parties.

7.2 Measurement Inconsistency and Grain Transit

Scribes were aware of standard variance and developed means to assess value and move between standards. But this is not the same as an awareness that their observations were limited by the instruments themselves. Indeed, the reason for reassessment, other than when crossing between institutional standards, is seldom provided. Moreover, it is seldom stated that a full remeasurement actually occurred. Perhaps there is a good reason for this. As noted above, remeasurement in the Classical Greek world was both costly and time-consuming. If this was the case in Mesopotamia as well, then one can hypothesize that the full remeasurement of value would be rare and limited to points where personal trust broke down and was replaced by systems of institutional accountability.

However, full remeasurements did occur. This was hypothesized above (Sect. 7.1.3) for standard conversion with YBC 04224 line 42. Value was literally measured out by a standard vessel and each measure was counted, producing a full measurement. A full remeasurement is described by the Akkadian verb *šanûm*, which appears in AO 08493 line 9. The author of this balanced account, which describes the receipt and delivery of grain, and which was probably produced in Larsa in the fifty-first year of *Rīm-Sîn* of Larsa's rule, uses the first-person form to state that the author himself remeasured a value of grain. He describes his physical receipt of *Sîn-rāmā*'s rations, 1 *gur* 1 *bariga* 4 *ban* grain in Ašdubba (lines 1 through 6), payment of various transit fees (donkey, gate, exit fees in lines 7 through 8), and then probably the complete remeasurement of this grain, which produces only 1 *gur* 1 *bariga* 2 *ban*, upon arrival in Larsa (line 9). 2 *ban* is unaccounted for between the original measurement and the remeasurement, a five per cent difference. Had this been the fees described in lines 7 and 8, then they would be itemized. This is not so, and the personal account suggests that the author was paying out of pocket. The difference probably derives from somewhere else. Where did this discrepancy come from?

This kind of discrepancy is visible in a series of texts from the city of Larsa itself during the early period of *Rīm-Sîn*'s reign (1822–1763 BCE). This group of texts, attributed to the grain storage bureau in Sect. 4.1, is first and aptly described by Breckwoldt (1995/1996). As Breckwoldt notes, these texts describe the shipment of grain from several towns, probably constituting the city of Larsa's hinterland, to

Larsa itself and then to various storehouses scattered throughout the city.[11] At least four scribes are suggested, who produced twelve delivery texts, while another scribe is the author of four texts dealing with expenditures from this bureau.

The use of ‘še-gur’ instead of the more typical ‘gur še’ to render ‘*gur* of grain’ is a distinct archival practice, which suggests all these texts were produced in the same place or under the same authority. Each text from this bureau takes the form of a balanced account in which the original grain shipment appears as capital and the quantity stored in each granary is stated, as well as each individual transportation cost. The total of grain, consisting of these disbursements, appears next and is followed by the phrase ‘delivered and disbursed’ in all but two texts attributed to scribe E of the archive. In every text, the total grain disbursements are followed by the difference between these disbursements and the capital.

An additive and subtractive procedure is evident in these texts. Grain was measured, shipped and, similar to AO 08493 of the *Sîn-rāmā* archive, remeasuring probably took place after arrival in the new city and after fees had been paid. It was suggested in Sect. 3.1.3 that these balanced accounts represent several documents. Under this hypothesis, one set of texts was drawn up at the measurement of the grain shipment in advance of transport, in order to maintain accountability until arrival in Larsa. Upon arrival, deductions reflecting transportation costs were made from this grain and the total that was delivered to the storage point was measured to verify delivery. This is represented by the expenditure section. The whole completed account was then drawn up, stating the original sent in the capital section and then the amount on arrival and shipping costs, all followed by the difference, i.e. the balance.

Reassessment upon arrival in Larsa does not seem to be remeasurement based on a sample product as described above. In each instance of sample measurement, some qualifier occurred and in several instances a change rate was provided. In an environment of administrative delegation like the grain storage bureau, such a qualifier is expected. Indeed, as shown in Sect. 7.1.3, such a qualifier is suggested with YBC 07194 of this archive. Line 8 states ‘9(aš) 2(bariga) gur *ru-ub-bu-u*$_2$ *ša* $^{\text{giš}}$ba-ri$_2$-ga,’ ‘9 *gur* 2 *bariga* the increase of the *bariga*-standard vessel’. There is no qualifier stating or implying a sample measurement, so this kind of remeasurement seems unlikely.

It seems more likely that a full remeasurement would take place because of the number of persons involved in shipment. In Sect. 4.1 it was noted that a delivery agent and several conveyors were certainly involved in preparing and overseeing transit. In addition, there were porters and probably a pilot for the boats. Authority and responsibility are delegated at multiple points in the transit process so that a full assessment would be likely because trust was difficult to achieve in this environment. A shipment could be tampered with; bags can be opened to remove grain and

[11] For a discussion of these various towns, see Breckwoldt (1995/1996: 68–69, 69–75) for this shipment and intermediaries in shipment, and pages 75–76 for the various storage facilities mentioned in the texts. See also Sect. 4.1 here.

then sewn shut again. It is clear from the texts that a marginal discrepancy is expected with transit—up to six per cent under certain conditions but often less than one per cent. A full remeasurement would both assess how much grain an authority possessed and deter losses associated with tampering. Sample measurements, which would only check the quality of one random or preselected sack, would be less of a deterrent because it is less likely that an excessive deficit would be found. To assure accountability was met and, more importantly from the administrator's perspective, to limit culpability against loss, it was in the interests of all parties to observe the remeasurement of the shipment just as it was in the interests of the bureaucracy to know just how much grain they actually had. It is therefore proposed here that a full remeasurement was carried out with grain shipments.[12]

Table 7.6 presents a summary of a grain shipment account. In this instance, difference is very little, only 6 *gur* 1 *bariga* out of a total $10 \times 60 + 2 \times 60$ *gur* or a 0.86 per cent difference between the shipped value and the delivery and disbursements. Table 7.7 presents each difference in each text. It illustrates several points. First, most differences are less than one per cent, although five of the twelve examples are greater than one per cent and up to possibly 5.44 or 5.33 per cent. Two of these present an additional error or mistake of some form. In YBC 05494 the difference is rounded up by 4 *sila*. In YBC 07194 it is a calculation mistake. There is thus systematic evidence for a discrepancy associated with the full remeasurement of grain, as well as awareness of this discrepancy as suggested by stated differences in the texts. Was there a means to offset this variety of discrepancy? If so, this would suggest that the scribes in the bureau were aware themselves that their measurement instruments were not completely reliable.

In answering this question, another important point must be emphasized: there are varying degrees of how exact a measurement is in the texts. Table 7.8 represents the lowest value within each text from the grain storage bureau, as well as the per

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[12]Johnstone (2011: 49–50) provides a description of an instance where full measurement took place—an accounting of the *epistatai* of Eleusis in which the colony of *Imbros* was late in shipping its offering to Eleusis. This account included the handling costs and sale prices of the offering as well. A measurement expert, the *prometretes*, was hired to carry out the actual measurement. Interestingly, the accounting shows inconsistency between the account received and the measurement. 'This suggests that when the *epistatai* received the contributions, they wrote down the reported amount of each, but did their own measuring only when they had all the grain together. (Thus, the porters had to bring out the grain because it had already been stowed)' (*ibid.*: 50). Johnstone describes a similar context as that shown with grain transport at Larsa—grain is shipped from a distance, ostensibly assessed before shipment, and then once it is all gathered together, fully reassessed upon delivery. While Johnstone's account does not confirm the hypothesis presented here concerning remeasurement, it certainly supports the premise that when authority is delegated at multiple points in a transaction, such as shipment from a distance, it is in the interests of bureaucrats involved to fully remeasure the quantity in question to deter tampering and limit culpability, while it is in the state's interests to know the quantity they actually have.

Table 7.6 Calculation by addition/subtraction in YBC 06231

Line	Notes	Quantity				
Capital						
1		10 × 60	2 × 60			
3	Total shipped	10 × 60	2 × 60			
Expenditures						
6	Delivery	10 × 60	1 × 60	10 *gur*	1 *bariga*	
8	Various ship fees			36 *gur*		
9	Drinks			2 *gur*	2 *bariga*	
10	*makkû* fee				3 *bariga*	1 *ban*
11	Grain porter wages			4 *gur*	2 *bariga*	5 *ban*
12	Extant total delivered/disbursed	10 × 60	1 × 60	53 *gur*	4 *bariga*	
	Difference			6 *gur*	1 *bariga*	

cent difference between measurement values before shipment and after delivery. Ordering is by lowest witnessed measurement value, first at *sila*, *ban* and *bariga*, then by text number. Five of these twelve texts measure down to *sila* measurement values, five texts state measurement values down to *ban* measurement values, while two more measure down to *bariga* measurement values. Indeed, the fact that *sila* are rounded off from the difference in YBC 05494 suggests this text was more concerned with *ban* measurement values than with *sila* in its result. Scribe E only measures to *ban*, *Ṣillī-Šamaš* seems to prefer measuring to *ban* as well, although he does measure down to *sila* in one text (YBC 07194), *Sîn-māgir* is comfortable working with *sila* in Riftin 1937: no. 054, but limits values to *bariga* with AO 06763, while *Sîn-errēš* is comfortable measuring down to *sila* as well.

It seems, then, that an exact measure was not always stated in the texts, nor deemed necessary. While scribes like *Sîn-māgir* and *Ṣillī-Šamaš* are capable of making measurements exact to the *sila*, they do not always make such exact measurements, and some scribes like scribe E do not even bother to measure down to *sila*. Remeasured values are perhaps rounded off just as *sila* is truncated off the difference in YBC 05494, and this rounding is based on scribal preference and conditions. How exact a scribe measures down to is, then, a matter of scribal preference. What explains this?

At each level of truncation witnessed in Table 7.8, whether *sila*, *ban* or *bariga*, there are significant inconsistencies in differences. However, this significance decreases as granularity decreases in fineness. With truncations at *sila* inconsistency produces differences between 0.36 per cent and possibly 5.44 or 5.53 per cent with

Table 7.7 Measurement error in the grain storage bureau

I. Text	II. Shipped	III. Delivered and disbursed	IV. Difference	V. Per cent difference (%)	VI. Scribe
YBC 05580	10 × 60 *gur*	9 × 60 + 59 *gur* 1 *bariga*	4 *bariga*	0.13	*Ṣillī-Šamaš*
YBC 06663	4 × 60 *gur*	3 × 60 + 59 *gur* 2 *ban* 4 *sila*	4 *bariga* 3 *ban* 6 *sila*	0.36	Uncertain
YBC 06985	10 × 60 *gur*	9 × 60 + 5 *gur* 4 *bariga*	2 *gur* 1 *bariga*	0.37	Uncertain
Riftin 1937: no. 054	3 × 60 *gur*	2 × 60 + 59 *gur* 1 *bariga* 3 *ban* 6 *sila*	3 *bariga* 2 *ban* 4 *sila*	0.38	*Sîn-māgir*
AO 06763	10 × 60 *gur*	9 × 60 + 57 *gur*	3 *gur*	0.5	*Sîn-māgir*
YBC 07310	10 × 60 *gur*	9 × 60 + 56 *gur* 2 *bariga* 5 *ban*	3 *gur* 2 *bariga* 2 *ban*	0.57	Scribe E
YBC 06231	10 × 60 + 2 × 60 *gur*	10 × 60 + 1 × 60 + 53 *gur* 4 *bariga*	6 *gur* 1 *bariga*	0.86	*Ṣillī-Šamaš*
YBC 07187	10 × 60 *gur*	9 × 60 + 52 *gur* 1 *bariga* 2 *ban*	7 *gur* 3 *bariga* 4 *ban*	1.28	Scribe E
YBC 08774	7 × 60 *gur*	6 × 60 + 52 *gur* 4 *bariga* 5 *ban* 4 *sila*	7 *gur* 6 *sila*	1.67	*Sîn-errēš*
YBC 05494	9 × 60 + 30 *gur*	9 × 60 + 18 *gur* 5 *ban* 4 *sila*	11 *gur* 4 *bariga* 1 *ban*[a]	2.07[a]	Uncertain
Riftin 1937: no. 051	4 × 60 *gur*	3 × 60 + 53 *gur* 4 *bariga* 2 *ban*	6 *gur* 4 *ban*	2.56	Uncertain
YBC 07194 (a)	4 × 60 *gur*	3 × 60 + 46 *gur* 4 *bariga* 4 *ban* 2 *sila*	13 *gur* 1 *ban* 8 *sila*	5.44	*Ṣillī-Šamaš*
YBC 07194 (b)		3 × 60 + 46 *gur* **3 *bariga*** 4 *ban* 2 *sila*	13 *gur* **1 *bariga*** 1 *ban* 8 *sila*	5.53[b]	

[a]Rounded value
[b]Uncertain mistake in text

five texts. Shipments are between 3 × 60 *gur* and 9 × 60 + 30 *gur*. *ban* measurement values exhibit less diversity in differences: between 0.13 and 2.56 per cent with five texts and shipments between 4 × 60 *gur* and 10 × 60 + 2 × 60 *gur*. With truncation at *bariga*, the difference between the amount shipped and received comes to 0.37 and 0.5 per cent between two texts with shipped values between 4 × 60 *gur* and 10 × 60 *gur*. While this sampling is small, it is safe to suggest that when scribes rounded by truncating measured values, apparent difference in measurement values before and after shipment decreased. That is to say, as granularity decreased, apparent inconsistency between measurement values decreased.

Table 7.8 Truncation and error in the grain storage bureau

I. Text	II Shipped	III. Delivered and disbursed	IV. Difference	V Lowest measure	VI. Per cent difference (%)	VII. Scribe
Riftin 1937: no. 054	3 × 60 *gur*	2 × 60 + 59 *gur* 1 *bariga* 3 *ban* 6 *sila*	3 *bariga* 2 *ban* 4 *sila*	*sila*	0.38	*Sîn-māgir*
YBC 05494	9 × 60 + 30 *gur*	9 × 60 + 18 *gur* 5 *ban* 4 *sila*	11 *gur* 4 *bariga* 1 *ban*[a]	*sila*	2.07[a]	Uncertain
YBC 06663	4 × 60 *gur*	3 × 60 + 59 *gur* 2 *ban* 4 *sila*	4 *bariga* 3 *ban* 6 *sila*	*sila*	0.36	Uncertain
YBC 07194 (a)	4 × 60 *gur*	3 × 60 + 46 *gur* 4 *bariga* 4 *ban* 2 *sila*	13 *gur* 1 *ban* 8 *sila*	*sila*	5.44	*Ṣillī-Šamaš*
YBC 07194 (b)	4 × 60 *gur*	3 × 60 + 46 *gur* **3 *bariga*** 4 *ban* 2 *sila*	13 *gur* **1 *bariga*** 1 *ban* 8 *sila*	*sila*	5.53[b]	
YBC 07211	7 × 60 *gur*	6 × 60 + 52 *gur* 4 *bariga* 5 *ban* 4 *sila*	7 *gur* 6 *sila*	*sila*	1.67	*Sîn-errēš*
Riftin 1937: no. 051	4 × 60 *gur*	3 × 60 + 53 *gur* 4 *bariga* 2 *ban*	6 *gur* 4 *ban*	*ban*	2.56	Uncertain
YBC 05580	10 × 60 *gur*	9 × 60 + 59 *gur* 1 *bariga*	4 *bariga*	*ban*	0.13	*Ṣillī-Šamaš*
YBC 06231	10 × 60 + 2 × 60 *gur*	10 × 60 + 1 × 60 + 53 *gur* 4 *bariga*	6 *gur* 1 *bariga*	*ban*	0.86	*Ṣillī-Šamaš*
YBC 07187	10 × 60 *gur*	9 × 60 + 52 *gur* 1 *bariga* 2 *ban*	7 *gur* 3 *bariga* 4 *ban*	*ban*	1.28	Scribe E
YBC 07310	10 × 60 *gur*	9 × 60 + 56 *gur* 2 *bariga* 5 *ban*	3 *gur* 2 *bariga* 2 *ban*	*ban*	0.57	Scribe E
AO 06763	10 × 60 *gur*	9 × 60 + 57 *gur*	3 *gur*	*bariga*	0.5	*Sîn-māgir*
YBC 06985	4 × 60 *gur*	9 × 60 + 57 *gur* 4 *bariga*	2 *gur* 1 *bariga*	*bariga*	0.37	Uncertain

[a]Rounded difference leads to *ban* measure
[b]Uncertain mistake in text

Several possible caveats need to be addressed here. To begin with, in the grain storage bureau, is this a matter of scribal competence? *Sîn-māgir* does produce differences at 0.5 per cent or less when measuring to *bariga* and to *sila*, which could suggest that scribal competence was a factor. However, this seeming competence appears to be an exception rather than the rule. Scribe E produces differences of 0.57 and 1.28 per cent when evaluating shipments of 10 × 60 *gur* to the nearest *ban* measure. *Ṣillī-Šamaš* produces differences of 0.13 and 0.86 per cent when evaluating 10 × 60 *gur* and 10 × 60 + 2 × 60 *gur* respectively, but over five per cent when evaluating only 4 × 60 *gur* grain. However, the production of more than one text could only be securely attributed to three scribes, a sample size far too small to state with any certainty how scribal competence affected measurement inconsistency. Also, as alluded to above, it is difficult to tell whether it was the scribes themselves carrying out measurements, whether they oversaw measurements, or whether they simply made note of the measured amounts. This is not stated, so that it is not possible to assess how scribal competence affected inconsistency witnessed in measurement values before and after shipments.

Nor does the shipment size seem to be a deciding factor in measurement inconsistency. Out of four texts that measure to *sila* measurement values, the greatest inconsistency is exhibited between two shipments of 4 × 60 *gur*, with much less difference between one shipment of 3 × 60 *gur* and another of 7 × 60 *gur*. All four texts that measure to *sila* are produced by different scribes. Concerning measurements to *ban* measurement values, the most significant difference, 2.56 per cent, occurs with the smallest shipment, 4 × 60 *gur*, while the greatest inconsistency between differences occurs with the two largest shipments: differences of 0.57 and 1.28 per cent occur when scribe E evaluates shipments of 10 × 60 *gur* to the nearest *ban* measure. Finally, with bariga, evaluations of 4 × 60 *gur* and 10 × 60 *gur* produced two of the smallest differences seen in the texts, 0.37 per cent and 0.13 per cent respectively. It is hard to see a pattern other than that outlined above: apparent inconsistency between measurement values decreases as granularity decreases.

The evidence afforded by the grain shipment texts of the grain storage bureau could point to a concept of precision, although certainly not in its modern, scientific sense: the actors are not measuring several times over and then calculating a precise value out of this. Instead, the bureaucrats in the grain storage bureau are measuring twice and finding the difference between an original measurement value and the remeasured value upon receipt. These texts make clear that a difference was expected when remeasuring grain. Moreover, there is a sense from these texts that exact measurements could not be reliably obtained. While capable of measuring down to the *sila*, it was not always deemed necessary and perhaps indicates inexact instruments at this juncture, and even a sense of accuracy and uncertainty of measurement as defined above. When truncating a measurement, that is, when the *sila*, for instance, is not accounted for, this may be a means to assure a more certain value, not a true value.

Perhaps, instead of using terms like uncertainty of measurement, precision, accuracy or true value at this point in history, it would be better to talk about measurement inconsistency, exactness and certain value. Measurement inconsistency is to be understood as the potential variance between a stated measurement, often referring to a previous measurement, and a second measurement. Exactness describes an attempt to offset this variance through rounding by truncation of lower units. The authors are not interested in a true or ideal value, but instead a certain value, that is, a value that the author certainly had.

Finally, these concepts seem to apply across milieus. The grain storage bureau is a bureau archive; the texts in this archive record transactions on behalf of a state apparatus and employ several scribes acting as officials within this bureau. However, AO 08493 records a household transaction and belongs to a personal household archive. Grain enters into a household. This is not simply a public practice but a personal practice as well. The scribes seem generally aware of measurement inconsistency and thus, at some point early in a scribe's upbringing, before he began to study and work in bureau or household economics, he probably learned this aspect of metrology.[13] Unfortunately, there are no texts relating to measurement inconsistency, nor a concept of exactness as described here. The phenomenon is localized to economic texts. Thus, it must be asked, can traces of and reasons for this phenomenon be found in the scribal curriculum?

7.3 Production and Conception of Value

To answer this question, it may help to examine further the nature of the numbers themselves and ask did the elementary scribal education define acceptable values? and did it influence number use? First, as shown in Sect. 2.2, a distinction existed between metrological lists and then metrological tables, which were presented early in a scribe's mathematical education. Lists presented each measurement value in relation to other measurement values that make up a metrological system such as capacity, as is used in the grain storage bureau. Thus, they present measurement values as parts of a metrological system with larger and smaller values corresponding to different measurement units within each system. The position of a value within a system also corresponded to a specific size. *Sila* is smaller than *ban*, which is smaller than *bariga*, and so forth.

As stated in Sect. 2.2, the metrological lists were probably learned early in a scribe's mathematical education while, as shown in Sect. 7.1.1, the relative sizes of measurement values found on the metrological lists and tables for capacity were

[13]These practices were probably not limited to grain and capacity measurements, but also to weights (for a discussion of weights, see above, Sect. 7.1.1).

possibly reinforced in the advanced phase of education, when texts such as YBC 04669 could appear. In YBC 04669, the lengths, depths and transversals of various capacity measures are computed so that their relative sizes and values are known. Thus, if texts such as YBC 04669 were a common feature of the scribal curriculum, then the relative size of these measurement values would have been explored further in the advanced phase of scribal education.

Second, in the metrological tables presented in Sect. 2.2.2, measurement values found on these lists were associated with a SPVN number so that each measurement value could be transformed to a sexagesimal number, from 1 to 60, before multiplication and then back after this multiplication. Both *sila* measurement values as well as the *sar* system for area and volume were subdivided into *gin* and then *še* measurement values of the weight system so that these initial weight measurement values appear in the same form, with the same corresponding SPVN numbers, in the capacity and area systems. Tables like this were learned after metrological lists in the scribal curriculum.

There are consequently two different ways in which a measurement value was understood as expressed in the scribal curriculum. The first is by measurement value alone and corresponded to the very beginning of the initial period of mathematical education when metrological lists were learned. The second is by a measurement value's transformation into SPVN. This was expressed in metrological tables.

In addition, lists and tables presented acceptable granularity of a measurement value. Fractions of measuring units exist in these lists to subdivide different measurement values. These fractions were one-6th (igi 6(diš)-gal$_2$), one-4th (igi 4(diš)-gal$_2$), as well as 1/3, 1/2, 2/3, and 5/6 of a measuring unit, the latter four appearing with their own, special signs. Of these fractions, one-6th (igi 6(diš)-gal$_2$) and one-4th (igi 4(diš)-gal$_2$) only appear partitioning *gin*. Measurement values themselves were presented as a combination of integer numbers and fractions:

1 *sila*	1
1 1/3 *sila*	1:20
1 1/2 *sila*	1:30
1 2/3 *sila*	1:40
1 5/6 *sila*	1:50
2 *sila*	2

1/3, 1/2, 2/3 and 5/6 occur with 1 *sila*, producing finer granularity. Corresponding to this finer granularity in measurement value is a SPVN number with more digits. Thus, when 1/2 *sila*, corresponding to 30 in SPVN, is appended to 1 *sila*, which corresponds to 1 in SPVN, the measurement value achieves finer granularity while the SPVN number, 1:30, has more digits.

At the same time, different measurement units can occur together to produce a measurement value on the metrological lists and then tables. This also creates finer granularity:

29 *še*	9:40
One-6th *gin*	10
One-6th *gin* 10 *še*	13:20
One-4th *gin*	15
One-4th *gin* 5 *še*	16:40
1/3 *gin*	20

10 *še*, corresponding to 3:20 in SPVN, is appended to one-6th *gin*, corresponding to 10 in SPVN, to produce one-6th *gin* 10 *še* corresponding to 13:20 in SPVN. This, again, produces finer granularity in measurement values as well as more digits in SPVN numbers.

Finally, the lists and tables could also produce a conceived upper and lower limit for easily measured and computed values. The lowest measurement value in weight was 1/2 *še* (written 1/2 še), while the highest value for weight, the upper limit, was 1×60^3 *gu* (written 1(šargal)^{gal} gu$_2$). The metrological lists and tables provide basic components to express value. These components allow for finer and coarser granularity and could be appended to one another. What would happen when a measurement value appeared beyond the upper or lower limit of each system? Answering this question will help determine if these lists and tables did, indeed, define acceptable values and influence number use.

7.3.1 Below the Lower Limit: The Expert

While no texts could be found in which the upper limit is exceeded, a very few mathematical texts, produced by masters and novices alike, do go below the lower limit, so this question can be explored. Most examples produced by a master scribe compute area and volume measurement values using the *še* and then *gin* measures of the weight system, although an example of height also exists. By presenting the work of masters as well as students it is possible to see how the expert as well as the novice coped with fractions below and finer than those presented in the metrological lists and tables.

Master scribes seemed quite apt at working with finer measurement values than those presented on the metrological tables, although examples are rare. Moreover, deviations from expected and stated values when presenting these fractions are even rarer. The work of master scribes shows how these fractions were used for both *še* measurement values, especially when measuring area, volume and, in one example, length measurement values.

Area and volume measurement values appear in problems 1 through 5 in YBC 04607. These problems present the parameters of five different brick types

Table 7.9 Fractions in YBC 04607, problems 1–5

Problem	Stated value	Expected value	Value type
1	12 *še* one-half *še*	12 1/2 *še*	Area
1	2 *še* and one-12th *še*	2 *še* one-12th *še*	Volume
2	18 *še*	18 *še*	Area
2	3 *še*	3 *še*	Volume
3	16 *še* one-half *še* and one-6th *še*	16 2/3 *še*	Area
3	2 *še* one-half *še* one-4th [and one-9th of one-4th še$^{?}$]	2 25/32 *še*	Volume
4	One-6th < *gin* > 3 *še* and one-3rd *še*	One-6th *gin* 3 1/3 *še*	Area
4	5 *še* one-half *še* and one-9th (of) one-half *še*	2 5/9 *še*	Volume
5	1/3 *gin* and 15 *še*	1/3 *gin* 15 *še*	Area
5	12 *še* one-half *še*	12 1/2 *še*	Volume

described, following Neugebauer and Sachs' typology, as brick types 1 through 5.[14] Each problem presents the length, width and depth of each brick and then asks for the area, volume and the volume's equivalent capacity for each as well. Other than brick type 5, areas or volumes present divisions of *še* measurement values below 1/2 (Table 7.9).

There are no mistakes in calculation. Each number, when fully extant, offers expected values for the calculations being carried out. The only possible exception is volume for problem 3, which is broken and therefore could have presented some discrepancy. Thus, the author presents one-12th *še* as well as 25/32 *še*—neither of which are found in the metrological lists or tables. While the calculation is carried out correctly, notation is not completely straightforward to the modern observer. Instead of the simple 1/2 sign, 'šu-ri-a' is written, which translated as 'one-half'. The author also wrote one-3rd *še* as 'igi 3(diš)-gal$_2$ še' rather than the simple symbol for 1/3 *še*. In addition, rather than using the symbol for 2/3 as would be expected, the author wrote out one-half *še* and one-6th *še*. None of these measurement values is found in the metrological lists or tables. The author certainly had a full repertoire of symbols, as is witnessed by his use of values greater than *še*. Thus, 1/2 *kuš* and 1/3 *kuš* appear in problem 1 or 2/3 *kuš* in problem 3, all using the expected signs.

[14]This typology is based on YBC 04607 (Neugebauer and Sachs 1945: 91–97) as well as another text of coefficients, YBC 05022 (*ibid.*: 132–139). An additional typology was produced by Powell (1982: 116–123) based on the volume of each brick type as laid out in Neugebauer and Sachs (1945) but with a hypothetical brick, type 12 brick, suggested to link the system together. Finally, a further typology of bricks was produced by Friberg (2001: 73–84) which classifies bricks based on shape. All three typologies are certainly useful. Because Neugebauer and Sachs' typology is based directly on the textual sources, it is a better presentation of how the ancient Babylonian scribes understood their own system to account for brick and is followed here.

Several reasons can be suggested for this. First, 1/2 *še* is the lowest value on metrological lists and tables. There is no 1/3, nor even a 2/3 *še*. Thus, with all fractional values omitted from the metrological lists and tables, the author writes out a full fractional form, even when a shorthand symbol is available, such as 'igi 3 (diš)-gal$_2$ še' rather than '1/3 še'. 'u_3', 'and', precedes a value whenever it is not found on a metrological list or table. Moreover, 'u_3', 'and,' does not separate one-half *še* and whole *še*. The author simply writes out the lowest value as visible on metrological lists and tables when these values are present, even when 1/2 is present within another fraction such as 2/3 *še*. To produce 2/3 *še*, a value that does not exist on the metrological tables, the author simply performs an additive operation, writing out 1/2 *še* plus (u_3) one-6th *še*. This is seen in problem 3 for both area and volume as well as problem 4 for volume. Thus, 'u_3', 'and', separates values not found on metrological lists from values found on these lists. It states a remainder.

Another interesting point is that, with *še* only, each numerical value found or implied on the list is followed by a measurement unit, '*še*'. For instance, '12 *še* one-half *še*' is stated rather than '12 1/2 *še*'. This is different from, say, 8 1/3 *gin*, where the measurement unit *gin* follows both the integer number 8 and fraction 1/3. '*še*' also appears with, for instance, 'one-3rd' as well as 'one-9th of one-half'. The author is taking pains to present exactly which units made up fractions omitted from the metrological lists and tables: each time *še* appears it implies a part used to produce a measurement value. *še* is an important element because it shows how the author divided these lowest measurement values to produce fractions of measurement units from SPVN numbers.

The author of YBC 04607 uses an additive operation with measurement values outside of the metrological lists and tables within five fractions of measurement units, and in each fraction of a measurement unit delimits unities used to produce values by stating *še* after each numerical value. However, in at least one and possibly two fractions the author produces a fractional value by means of a division using a reciprocal. Thus, to produce '1/18th *še*' the author writes out 'one-9th of one-half *še*', or one-half divided by 9 (igi 9(diš)-gal$_2$ šu-ri-a) *še*.[15] Because '*še*' appears after this division, it can be suggested that the author viewed this value as a unity, that is, 'one-9th of one-half' is a contiguous component used to produce value. This is reinforced by the use of '*u*', 'and', between 1/2 še and one-9th of one-half še. Table 7.10 attempts to show how each fraction was constructed. Plus signs (+) show where 'u_3,' 'and', is present. Table 7.11 presents these very same

[15]'igi 9(diš)-gal$_2$ šu-ri-a' is understood here as a compound 'igi 9(diš)-gal$_2$' followed by 'šu-ri-a' followed by an unwritten genitive (–k) common to Sumerian. The use of the genitive 'of' implies this division. See Edzard (2003: 36–38) for genitive constructions. On page 37, Edzard notes the allomorph [(V)(k)] following a vowel (−V) concluding this construction. As an example, he writes 'ab-ba-eri(k) "the city elder" (absol.).' Discussing the distinct lack of a written −k, he notes 'it remains unknown what happened, phonetically speaking, to the final [k] of the genitive morpheme. That it did not disappear totally becomes clear from the OS spelling rule for the dative case particle [r(a)]'. For our purposes it is simply important to note that a written (−k) is not expected following a vowel at the end of a genitive chain.

Table 7.10 Construction of fractions in YBC 04607, problems 1–5

Problem	Fraction construction				Fraction value	Value type
1	12 *še*	1/2 *še*			= 12 1/2 *še*	Area
1	2 *še*	+ 1/12 *še*			= 2 1/12 *še*	Volume
3	16 *še*	1/2 *še*	+ 1/6 *še*		= 16 2/3 *še*	Area
3	2 *še*	1/2 *še*	+ 1/4 [*še*	+ 1/9 of 1/4 *še*]	= 2 25/32 *še*	Volume
4	3 *še*	+ 1/3 *še*			= 3 1/3 *še*	Area
4	5 *še*	1/2 *še*	+ 1/9 of 1/2 *še*		= 2 5/9 *še*	Volume

Table 7.11 Transformation of fractional construction in YBC 04607, problems 1–5

Problem	Fraction construction in SPVN				Fraction in SPVN	Value type
1	4	10			= 4:10	Area
1	40	+ 1:40			= 41:40	Volume
3	5:20	10	+ 3:20		= 5:33:20	Area
3	40	10	+ 5	+ 6:40 × 5	= 55:33:20	Volume
4	1	+ 6:40			= 1:6:40	Area
4	1:40	10	+ 6:40 × 10		= 1:51:6:40	Volume

fractional constructions when transformed to SPVN. 6:40 is the reciprocal of 9 while 5 multiplied by 6:40 is 33:20 and 10 multiplied by 6:40 produces 1:6:40. Values are splintered based on a few SPVN numbers: 10, 6:40 and 5. Perhaps SPVN numbers are broken up to facilitate transformation into measurement values. The author of YBC 04607 was clearly able to work with smaller fractions and units not present on the metrological lists and tables, although it was also clearly difficult or unusual for him to express these fractions. These fractions are divided into parts of fractions that perhaps suggest transformation from SPVN.

Difficulty is seen in producing fractions outside of those seen in the metrological lists of weights and through this area and volume with YBC 04607. YBC 04669 problem 9, where the size of a 1 *gin* measuring vessel is described, exhibits this same phenomenon, although with length units rather than area and volume. Problem 9 presents a height of this vessel as 3 1/2 *šusi*, even if the lowest measurement value on the metrological lists and tables was 1 *šusi* for both length and then height. Thus, the author felt it necessary to go below the lowest value of a metrological list. However, this value is a rounded value. As Proust (forthcoming) notes, the author omitted 2/5 *šusi* from this total, which would have produced 9/10 *šusi*. Following Proust, 2/5 was probably not part of the normal repertoire of signs. The author of this text does not take the same pains to produce a transparent

fractional value as the author of YBC 04607 did to produce fractions of *še*. He uses the typical 1/2 sign and places this between the integer number 3 and the measurement unit *šusi*. Thus, there is no distinction between what is present on the metrological tables and what is computed below it. The author is not interested in producing a complex fraction, only stating a close approximation. He rounds down for simplicity's sake, truncating 2/5.

The master scribes and teachers could work with measurement values that extend beyond metrological lists and tables. However, it is clear that there was some difficulty in carrying this out, or at the very least in expressing measurement values that extended below the lowest measurement values on metrological lists. Scribes were not always averse to writing an approximate measurement value when this happened. If these fractions of measurement units posed a challenge for the master, what about the student? This would show how much the aspiring scribe relied on metrological lists and tables to define granularity and value.

7.3.2 Below the Lower Limit: The Novice

A group of six (type IV) exercise texts from Nippur, discussed most recently by Proust (2007: 193–198), can help to answer this question. They offer evidence for students or less experienced scribes coping with fractions of measurement units below those present on the various metrological lists and tables. Each text presents a calculation of area, stating a problem presented with measurement values, a solution in SPVN numbers and an answer stated in measurement values. Discrepancy between expected and stated values are much more prevalent and not always intentional, as was the discrepancy in YBC 04669 problem 9. Table 7.12 sums up these texts' answers.

First, as is seen in YBC 04607, the measurement unit *še* often appears to signify a part used to produce a measurement value, whether this part is found on the metrological list or not. Thus, for instance, NI 18 shows '13 *še* one-4th *še*' while IM 57828 shows '9 *še* one-5th (of) a 3rd is of *še*'. While this is not regular, there does seem to be a tendency towards this partitioning system. Indeed, with UM 29-15-481 problem 1, the measurement unit *še* appears between the integer number and fraction of *še* while it does not in problem 2. Inconsistency can be understood as an epigraphic mistake; the author simply omits an intended grapheme.

Second, in five out of seven problems there is a deviation from expected value in some form, sometimes several deviations, beyond the simple epigraphic mistake just mentioned. In NI 18 there is both a mistake in calculation as well as a discrepancy in transformation between an SPVN number and the stated measurement value. The author wrote one-4th *še* rather than 1/3 *še*. In UM 55-21-076 it is difficult to tell whether this is a mistake in epigraphy where the author mistakenly added an extra wedge, producing 2/3 *še* rather than the expected 1/3 *še*. Indeed, only in NI 18 can a deviation from expected value be traced to a calculation mistake. The novice scribes prove reasonably adept at working with SPVN. They

Table 7.12 Fractions in type IV tablets from Nippur

I. Tablet	II. Extant value	III. Expected value	IV. Per cent difference	V. Discrepancy type
NI 18	13 *še* one-4th *še*	14 *še* 1/12 *še*	5.32%	Calculation
		13 *še* 1/3 *še*		Transformation
UM 55-21-076	1/3 *gin* 25 2/3 *še*	1/3 *gin* 25 1/3 *še*	0.33%	Orthography/ transformation
IM 57828	9 *še* one-5th (of) a 3rd is of *še*	9 *še* one-6th *še* + 1/8 of one-6th *še*	1.32%	Rounding
IM 57846	One-4th […]	1/3 *gin* 10 *še* 1/12 *še*	Uncertain	Transformation? rounding?
UM 29-15-192	One-3rd of *še*	1/3 of *še*	None	None
UM 29-15-481 1	1/3 *sar* 8 2/3 *gin* 16 *še* 1/2 *še*	1/3 *sar* 8 2/3 *gin* 16 *še* 1/2 *še*	None	None
UM 29-15-481 2	1/2 *sar* 6 1/3 *gin* 26 1/2 *še*	1/2 *sar* 6 1/3 *gin* 26 one-4th *še*	0.0038%	Rounding

only exhibit difficulty with transformation from SPVN numbers to measurement values that do not exist on the metrological lists and tables. Only two out of these five discrepancies can be understood with any certainty as intentional, the result of rounding: IM 57846 and UM 29-15-481.

7.4 On Measurement Theory and Practice

It is safe to suggest that the metrological lists and tables did define acceptable values. For a master, any fraction of a measurement unit could probably have been produced and manipulated, although these values were unwieldy. For a student, measurement values outside of those presented on the metrological tables were difficult to use at best. Both master and students made attempts to show how fractions are formed when transformed from SPVN numbers to measurement values. Both did round when they felt it prudent. While students were required to produce these values when asked, it can be reasonably supposed that they would not work in values outside of those found on the metrological lists and tables by choice. When values below those stated on the table were found, these would probably be ignored in most situations. Thus, when expressing value in economic texts, scribes would have rounded them down by truncation. If so, then the differences in metrological lists and tables produced in each microculture proposed in Chap. 2 would have an effect on how scribes produced truncated value. They would truncate based on values learned while memorizing metrological lists and tables.

As shown with the grain storage bureau, truncation can also occur when a value is not certain. The scribes were doubtless aware that their instruments could not produce a certain value. They were familiar with measurement inconsistency as defined above, and so they took steps to offset or limit the uncertainty associated with measuring, what was termed exactness above, at least with capacity measurements. Because the metrological lists and tables almost certainly defined acceptable values, it is safe to suggest that measurement inconsistency and exactness were learned when the lists and tables were learned.

Indeed, if learned in school, measurement inconsistency and exactness would fit into the early elementary phase of education, when the various metrological lists and tables were being explained to the young aspirant scribe. While this is highly speculative, the reason may be the distinction inherent in the difference between metrological lists where only measurement values are stated on the one hand, and metrological tables where SPVN number transformations are provided for these measurement values on the other hand. With the metrological tables, the presence of these SPVN numbers implies a calculation by means of multiplication of SPVN numbers. This is not the case with measurement inconsistency, which is purely a phenomenon of measurements themselves and witnessed only when a value is reassessed.

At the same time as metrological lists, especially the lists of capacity, were being learned, scribes were studying thematic lexical lists which included sequences associated with measurement standards and values (cf. Proust 2007: 158–162, citing Veldhuis 1997). It would make sense for measurement inconsistency and exactness to be learned at the same time as the metrological lists and the thematic lexical lists were learned. Perhaps a form of commentary took place while studying these lists. This commentary would have focused on measurement practice with each metrological system to make the future scribes competent in working with their measurement systems. Michalowski (2012: 48), following Civil (2009), states the significance of commentary, at least with the traditional advanced education:

> Perhaps more significant, in the context of this discussion, are the elusive traces of interpretive and speculative linguistic and philological commentary that must have accompanied some of the rote learning that is documented by the surviving student exercises.

A form of commentary probably accompanied mathematical texts, including metrological lists and tables as well as thematic lexical lists concerning metrology and measurement practices, and even in early elementary education. This commentary focused on practice. It would not be the highly erudite dialogue between scholars traditionally associated with commentary. Instead, it would be a dialogue between teacher and student usually associated with a school context, a dialogue that bridges theory and practice and makes coursework useful in the professional environment. One could even look to this commentary on the mathematical texts as a source for the 'traditionally accepted appropriateness' pointed to by Asper (2012: 58) as a source of 'false' error.

In any event, the ancient scribes were aware of the natures of discrepancies inherent in their systems of measurement, and they had developed ways to cope with these discrepancies. They were certainly aware of the effects the measurement values they used had on their work and lives, and consequently preferred conservative, more certain measurement values. While the scribes could produce very small measurement values, even values of finer granularity than are seen in the metrological tables, these values were difficult to work with at best and, as the grain storage bureau shows, somewhat inconsistent.

7.5 Conclusions

There is evidence of similar situations outside of the kingdom of Larsa. Arnaud, Michel and Joannès point to measurement by adding or subtracting weights from a weight pan so that, in the end, a weight assessment incorporates an additive or subtractive process (Arnaud et al. 1979: 34; Michel forthcoming; Joannès 1989: 127–136, esp. 133–136). To the weighing authority, equilibrium was important. However, because instruments were limited, equilibrium could not always be achieved and thus a close approximation was required. A term for this existed at Mari, *šîqum*, which denotes a written weight with a value near to what is stated. As with weight at Nippur and probably Larsa, there was an accepted margin of uncertainty at Mari:

> Cette marge d'incertitude acceptée serait alors à mettre au compte de la balance elle-même, car on voit que le spécialiste de la pesée pouvait jouer de manière élaborée sur ses poids, mais évidemment moins sur la balance. (Joannès 1989: 139)

Uncertainty was the result of the tools used and then, by necessity, was assumed and had to be accepted. According to Joannès, for Mari this uncertainty was offset by rounding during the weighing process—perhaps similar to truncation to offset measurement uncertainty, as described above.

While standards may reflect a uniform system of assessment throughout the kingdom of Larsa, the measures that made up these standards could vary significantly. Indeed, within a city, and even an institution, multiple standards could be used, standards that crossed microcultural and cultural boundaries. This was made strikingly evident with the appearance of the Syrian weights together with the Mesopotamian weights in the city of Ur and within the Ebabbar of Larsa. Personal standards also varied, as was seen in differences between individual weights within both the Syrian and Mesopotamian systems at Ur and in the Ebabbar at Larsa.

Standard variance led to uncertainty and inconsistency: at Nippur, Ur and Larsa, a five to six per cent variance was probably acceptable with weights. This assertion is made more certain when Mari and Old Assyrian evidence as laid out and discussed by Joannès and Michel respectively is considered. At the same time, the methods used to assess value show that the bureaucrats who produced these measurements were aware that these standards differed. They knew that standards

would vary in multiple ways, between systems, such as the Syrian and Mesopotamian systems, between institutions, such as the merchant and royal standards seen in YBC 04224, and between personal standards such as those witnessed at Ur. Thus, they needed methods to assess measurements produced by others. These tools were to fully remeasure value, sample measure value, and then estimate value based on custom.

The first is the physical reassessment of goods. This is seen perhaps in YBC 04224, dated to the reign of *Gungunum* and attributed to an unnamed scribe. This method was probably used to remeasure value at delivery of grain with the grain shipment texts discussed in this chapter. Physical remeasurement of goods, then, possibly occurs throughout the kingdom of Larsa's independent history. Its use suggests that the item being measured was present and measured out.

The reassessment of grain may suggest the importance of metrological lists as learned in the elementary phase of the scribal education. The lists presented each measurement unit's relative granularity within each measurement system. Indeed, as Proust (forthcoming) points out, the standard vessels found in the mathematical text YBC 04669 show similarities to the lexical entries present on the list for trees and woods found at Nippur. As stated above, following Proust (2007: 152–153), the metrological list for capacity was learned at the same time as thematic lexical lists like the list of trees and woods. YBC 04669 provides a direct link between standard vessels associated with measurement values found on the metrological lists and tables of capacity on the one hand, and lexical lists learned in the early phase of the scribal education. Thus, it supports the hypothesis that standard measurement and remeasurement were learned early on in the scribal education. If concepts such as measurement inconsistency and exactness were learned along with the metrological lists in the early scribal education, it may be tentatively posited that the appearance of measurement inconsistency in texts indicates the physical reassessment of goods.

A second method of reassessment was suggested with two other entries in YBC 04224. With this method, a sample measurement was taken to produce a change rate which was then multiplied against a previously assessed value. This produced a value to be added to or subtracted from a previously assessed value. A similar addition is seen in LB 1075, produced by *Sîn-iddinam* and dated to the thirty-ninth year of *Rīm-Sîn*'s reign. This method probably explains a standard conversion in YBC 07194 dated to the beginning of *Rīm-Sîn*'s reign and attributed to *Ṣillī-Šamaš* of the grain storage bureau. The use of this method suggests that a commodity was present and partially measured. However, it also used multiplication to produce the amount to be added or subtracted from the original total assessed value. Sample measurement, then, offers an example of estimation based on measurement and required qualification of how it was assessed in order to be transparent to the observers, both those writing and those reviewing an account. Phrases like 'sag il$_2$-la-bi', 'sag-bi$_2$ la$_2$' or '*ru-ub-bu-u*$_2$ *ša* $^{\text{giš}}$ba-ri$_2$-ga' provided such qualification. With LB 1075, a change rate was provided with the qualifier 'sag-bi$_2$ la$_2$,' allowing the reconstruction of how this calculation took place. Interestingly this looks similar to

what one would expect to compute revenue—a value is calculated out of an original measured value, which is to be added to or subtracted from this principal.

The third method is an estimation of value based on calculating by means of a conversion rate. This kind of value estimation is visible in YBC 04265, also attributed to *Nabi-Šamaš* B, YBC 04470, attributed to *Abu-waqar* and A.26378, attributed to *Ilīma-abī*. All these scribes were active during the reign of *Hammurābi* of Babylon. All three make up part of the system of merchant intermediaries used to assess excess state goods in silver and perhaps grain, all produced texts that gave the appearance of contracts, and all produced an estimation of what a disbursed value would be at delivery when measured in another standard. With YBC 04265, the conversion rate was produced out of a sample measurement and change rate. However, YBC 04470 and A.26378 state only the conversion rate so that it is likely there was no commodity remeasurement, whether full or in part, for these two conversions. Rates in these two examples were, then, based on agreed-upon custom and not observation. Again, calculation appears similar to what a revenue calculation would look like—here an original measured value is increased by multiplication.

Estimation of value, whether based on a change rate and addition, or on a conversion rate, suggests the importance of metrological tables and then numerical tables in that they involve a calculation by means of multiplication using customary conversion rates. Custom here might establish conformity similar to that seen with equivalency rates in Chap. 5. If SPVN was used, then it was used to carry out multiplication. The metrological tables helped to facilitate this multiplication by allowing measurement value to be transformed into SPVN, while the numerical tables, if memorized, facilitated calculation by means of multiplication in SPVN.

In converting between standards, a distinction can be suggested between observation by means of measurement, which reflects metrological lists, estimation by means of multiplication, which reflects metrological and numerical tables, and sample measurements to produce a change rate, which reflects both metrological lists as well as metrological and numerical tables. In all three instances, conversion did not necessarily reflect reality. The physical remeasuring of a commodity, including sample measuring, was limited by the measuring instruments, as was seen with the study of weights and scales. These instruments could not produce a certain value, as was seen in the grain storage bureau, so that the scribes who wrote down these values probably truncated to offset measurement inconsistency and produce a more certain value. However, sample measuring shows that a scribe skilled in measuring value could estimate differences that his personal standard produced against the personal or institutional standard another scribe was using. The discrepancy in YBC 07194 showed that sample measurement was imperfect—by producing a sample measure to convert value between two slightly different standards, the scribe compounded the discrepancy associated with a full remeasurement.

All of this may indicate that the scribes had a concept of margin of error.[16] In the case of measuring instruments, scribes certainly expected there to be a difference between expected value and measured value. This is seen with measurement uncertainty in the grain storage bureau and is especially clear in the difference shown in YBC 07194. In YBC 07194, the difference between the amount shipped and the amount delivered and dispersed, 5.53 per cent (or 5.44 per cent after a calculation mistake is accounted for) is almost double the next highest difference of 2.56 per cent found in Riftin 1937: no. 051. It also shows measurements to *sila* and exhibits a standard conversion by means of sample remeasuring and change rate estimations. If such a large difference was expected by the author of YBC 07194, *Ṣillī-Šamaš*, this would suggest that the scribe had a concept similar to the modern margin of error. In other words, he knew that both reassessments would produce a discrepancy, and these discrepancies could be significant when measuring to *sila*. Indeed, he may have accepted that a larger difference was more likely with two remeasurements, one full and one a sample. It is significant that *Ṣillī-Šamaš* measures to *ban* in two instances but chose to measure to *sila* only in YBC 07194. Perhaps he wanted to make the difference transparent precisely because there is both a full and a sample remeasurement in this text. This transparency limited his culpability. By truncating to *ban* he would have offset measurement inconsistency in favor of a more certain value, but at the same time he would have been less transparent, and he deemed transparency more important in this instance. Where *Ṣillī-Šamaš* truncated value in YBC 07194, compared to his other texts, underlines the importance of measurement inconsistency and truncation to offset this inconsistency in measurement and record keeping, as well as the need for administrators to be transparent. While unaware of percentages, it may be that scribes like *Ṣillī-Šamaš* had a concept similar to the modern ‘margin of error’ and so they also understood the idea of an acceptable discrepancy—amounts of up to six per cent in the right circumstances. Exactly how they understood or even computed this ‘margin’ cannot yet be shown.

Due to the nature of conversion with rates, value was only an estimation of an expected reality: either measurement was partial, or no measurement took place at all. The purpose of this was not to find a certain value, but an agreed-upon, approximate value—an estimation of value. This is an important distinction. With measurement inconsistency, a more certain value was sought because the actors producing a measurement were aware of the limits inherent in their measurement systems. In estimating values, the authors must have been aware of the potential deviation from reality, so they agreed upon an approximation of reality based on a customary rate. If interpreted correctly, YBC 07194 makes this distinction clear. Conversion by sample measuring and change rate only gave an estimated difference

[16]‘Margin of error’ is here understood as a range of value allowed for in case of a change in conditions, error in calculation or error in measurement.

to be subtracted from the original value. Full measurement produced a visible discrepancy between the original measured value before shipment and the remeasured value upon delivery. However, both measurement and rate estimations are means the actors employed to cope with uncertainty in their measuring and accounting systems, and with both measurement and rate estimations the metrological lists, tables and numerical tables helped to construct or limit value and thus provided a framework for conformity.

Chapter 8
Multiplication and Estimation

Abstract Two out of three methods to assess value discussed in Chap. 7 involved multiplication and can be considered estimations. However, neither of these two methods are found in the scribal curriculum, so that this chapter examines multiplication in order to find out why this may be. By exploring revenue rates, equivalency rates and then labor and wage rate calculations, it is found that there is a kind of economization of practice, where an algorithm presented in one text, such as an algorithm used to carry out an interest rate calculation, is adapted to another environment, such as a tax rate or change rate calculation, by means of commentary centering around tables. These made up building blocks of practice just as metrological lists and tables and numeric tables made up building blocks of calculation, so that much of an advanced scribal education may have taken place in professional environments and may have been made up of commentary. These estimations formed a second kind of error, a conceptual error, and the scribes were aware of this kind of error.

Value estimation, then, presents uncertainty. However, this uncertainty, in so far as standards are concerned, was made acceptable by agreed-upon practices and agreed-upon conversion rates. Thus, *Sîn-iddinam* and *Ṣillī-Šamaš*, as well as the unnamed author of YBC 04224, use an agreed-upon practice to measure a sample value and then estimate a full remeasurement in pursuit of a value assessment. Similarly, in presenting potential value when working between standards, *Nabi-Šamaš* B and *Abu-waqar*, both merchants in Larsa working during *Hammu-rābi*'s administration, are performing a calculation to assess value by means of these agreed-upon conversion rates. Moreover, the extant change rates and conversion rates each scribe used were expressed as measurement values that, when transformed to SPVN, matched the head numbers for multiplication tables presented in Sect. 2.2.3. Chapter 5 pointed to the importance of conformity when calculating with SPVN, suggesting that customary values made use of building blocks that were learned in a scribe's education. Indeed, with equivalency rates it was seen that calculation centered around a few reciprocal pairs and their associated multiplication tables.

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This brings the discussion to multiplication and estimation in the economic texts. Estimation was not new to the Old Babylonian period by any means, nor was estimation limited to the examples witnessed here. For instance, discussing food in the Ur III period, Hagan Brunke produced a study of rates used to estimate value in grain, bread and so forth.[1] In addition to the change and conversion rates of Chap. 7, rates were used to compute revenue, equivalencies and labor. This chapter will focus on calculation with these rates, asking 'how was each carried out'? 'is there evidence in the mathematical tradition for these rate calculations'? and 'were they aware of possible discrepancies associated with these calculations'? It is not enough to show the potential for conformity; the practices that would produce this conformity must be made explicit as well.

Sîn-iddinam and *Ṣillī-Šamaš* used an agreed-upon practice to produce and calculate with a change rate out of a sample measurement in LB 1075 and YBC 07194 respectively. *Abu-waqar*, *Ilīma-abī* and *Nabi-Šamaš* B used agreed-upon conversion rates to calculate standard conversions in YBC 04470, A.26378 and YBC 04265 respectively. However, no trace of either conversion rate calculation, nor change rate calculations, appear in the mathematical tradition. It was stated that these rates, as well as change rates, acted similarly to what we would expect with revenue rates. This is because both conversion and change rate calculations, as well as revenue calculations, are each based on direct proportionality, where the amount of change or revenue is directly proportional to the amount assessed. Thus, pursuing revenue calculation may help to explain the lack of evidence for calculations that used change and conversion rates.

8.1 Revenue Rates

To start with, is there evidence for revenue calculation in the Old Babylonian texts? If so, how was revenue calculated? In A.26371, a loan contract attributed to *Šēp-Sîn*, the merchant overseer of Larsa, a standardized measure, the 3 *ban* standard vessel, qualifies how a loan is to be paid back. Discussing Old Babylonian contracts, Huenergard (2000: 113) notes that the main topic usually goes first in a sentence or clause, even if this reverses normal word order. This is also typical of sentences and clauses in most economic texts. The main topic or focus goes first, regardless of how it affects sentence structure and, it should be added, the logical structure of a mathematical statement implied by each sentence or clause. Thus, in A.26371, focus is on 2 sixties 15 *gur* flour, the principal of a loan, and not on the mathematical process used to calculate interest for this loan, which appears in lines 2 and 3: the interest rate is 1 *bariga* per 1 *gur* of grain to be added upon maturity using the 3 *ban* standard vessel as the standard. How much will be paid is not stated, so that it is difficult to go beyond this statement by means of A.26371 alone.

[1]See Brunke (2011: especially Chap. 2, 'Wertäquivalenzen').

Indeed, the statement ‘daḫ-ḫe-dam’, ‘is to be added’, tells the reader that this statement is not an assessment of future value, only a statement of current value of the loan and indicates how the future value, that is the revenue from this loan, is to be assessed at harvest.

The loan itself does not, then, present a calculation; it only alludes to a future calculation, so that how this calculation may have looked must be sought elsewhere, starting with the mathematical tradition. Revenue is calculated in some mathematical texts, such as VAT 08521 from Uruk, specifically problem 1. Here an important methodological distinction must be made. In the present work it is understood that mathematical texts do not state reality, but instead present mathematical practice. Thus, with the first half of VAT 08521, problem 1, the author aims to produce the principal out of the total interest and the interest rate, a problem that was unlikely to appear in an economic environment, expressing Michalowski’s limit to practicality. However, the purpose of this text was to exploit the mathematical relationship between principal, interest and the interest rates, so that this problem, while unrealistic, prepared the student to calculate interest in a professional setting—the utility that could be transferred into the real world, as also suggested by Michalowski (2012: 47). While reality is not perfectly represented, and perhaps not even the goal of many mathematical texts, the mathematical relationships present in the text can be exploited to explain mathematical processes attested or alluded to in economic texts.[2]

Interestingly, while the rate is presented using statements of weight in VAT 08521, the actual principal and interest are only described in SPVN, as well as each step in the procedure. The interest rate of VAT 08521 is important for the purposes of this study. In line 5, the text states that 12 (in SPVN), which is the transformation of 12 *gin*, is raised to (multiplied by) SPVN 1, which is the transformation of 1 *mana*, to produce 12 (in SPVN), the interest revenue rate. The reciprocal of this rate, 5, is multiplied by 1:40, the actual interest, to produce 8:20, the principal in lines 6 through 7:

[2]The utility of mathematical texts as a means to interpret economic texts is examined in Middeke-Conlin, (forthcoming a). Note that this should not be read as a critique of Høyrup (2011). Here it is agreed that many mathematical texts exhibit his ‘supra-utilitarian mathematics’, or ‘mathematics that looks as if it has to do with the utilitarian tasks of scribes but at closer inspection turns out to go far beyond what could ever present itself in professional practice’ (*ibid.*: 6). It is only suggested that while the mathematics found in the texts may ‘go far beyond what could ever present itself in professional practice’, such as the use of square roots in VAT 08521 problem 1, some parts of these texts still reflected reality to an extent, and may express tools commonly used by professional practitioners, tools that were learned in a scribal curriculum and occasionally reinforced with problems that may otherwise have been supra-utilitarian, or tools on which these problems built to lend a utilitarian feel to first and then second-degree equations, as it were. Indeed, the ‘supra-utilitarian mathematics’ espoused by Høyrup reflected some reality, even if they were not expressions of reality themselves. They can thus be used here so long as they are used to support, clarify and partially explain a practice witnessed or suggested in the economic texts and are not used as the primary evidence for such a practice.

$1 \times 12 = 12$
$12 \sim 5$
$1{:}40 \times 5 = 8{:}20$

This operation is then reversed so that the interest rate itself is multiplied by 8:20, the principal, to produce interest:

$12 \times 1 = 12$
$8{:}20 \times 12 = 1{:}40$

12 *gin*, the interest of 1 mana, projects a rate of one-fifth, or twenty per cent, and is the customary interest rate for silver.[3] One fifth of the number 8:20 is 1:40. Thus, the calculation of interest in VAT 08521 is simple multiplication by one-fifth while the calculation of principal out of interest is a simple multiplication by five. A similar rate is described with grain in YBC 04698 statement 1: for every 1 gur grain, 1 bariga is the interest. This produced a very simple calculation. To produce the rate, one needed only transform 1 *gur* and 1 *bariga* to their associated SPVN numbers, find the reciprocal of the principal, and multiply this by the interest (Middeke-Conlin and Proust 2014: Sect. 6 Number 1):

1 *gur* → 5
1 *bariga* → 1
The reciprocal of 5 is 12
$12 \times 1 = 12$

Thus, statement 1 presents an interest statement. With statement 2 of YBC 04698, an interest rate of one-third, typical of grain loans, is seen. For every 1 *gur* grain, 1 *bariga* 4 *ban* (*ibid.*: Sect. 6 Number 2).

1 *gur* → 5
1 *bariga* 4 *ban* → 1:40
The reciprocal of 5 is 12
$12 \times 1{:}40 = 20$

A rate of one-fifth principal to interest seems to be important to the mathematical tradition and is the same rate for grain stated in A.26371.[4] Interest in VAT 08521 is also isolated from the principal and would be added to the principal, just as it ‘is to be added’ to the principal upon maturity in A.26371. Thus, VAT 08521, while pursuing a mathematical problem, reflects practice, to a degree.

[3]See, for instance, the model loans presented by Spada (2011: 213, Contract 2)

[4]While in VAT 08521, interest is calculated using SPVN, as Van de Mieroop (2002: 84–85) notes in his rapid survey of Mesopotamian debt and credit, ideal interest rates in the Old Babylonian period of twenty per cent and 33 1/3 per cent were based on the metrological systems, even if interest rates throughout Mesopotamian history could vary widely in actual practice. For the purposes here, this would mean that while institutional interest may have been originally based on metrological convenience, in practice this is not the case and thus the use of SPVN may have simplified calculation.

It is important to note that no economic text studied here presented a completed interest calculation. This is only to be expected: texts like A.26371 are predictive, based on current conditions, and thus revenues from interest are not expected to be calculated in these texts. This shows that measurement of the total principal and interest had not been carried out. Only the principal was measured to the agreed-upon measurement value. The authors were aware of the uncertainty associated with estimation and thus, when a transaction was not complete, it was not calculated. Moreover, as seen in Chap. 7, it was expected that measurements of grain would vary between assessments, while assessments of weight had a tolerable variance of around five to six per cent. The scribes could not have expected that an interest calculation would state reality but only an expected reality. There would be a discrepancy associated with measurement upon maturity. Thus, perhaps estimation is incomplete with interest calculations. Under this hypothesis, all the tools were put in place for an actor to estimate measurement value of interest out of principal, which once calculated, would then be measured out with the principal at maturation, but incorporating an acceptable discrepancy upon receipt of this measured value.

Some texts do state revenue, albeit a different sort of revenue. AO 08493, which was already presented in Chap. 7, offers a calculation of a tax on grain, the revenue of which is allocated to *Sîn-rāmā* as his grain ration. Thus, it reads in lines one through three:

1	1(aš) 1(bariga) 4(ban$_2$) gur še	1 *gur* 1 *bariga* 4 *ban* grain,
2	*na-am*$^{!}$*-ḫa-ar-ti* 2(u) gur še	the revenue of 20 *gur* grain
3	*ša i-na* 1(aš) gur še 2(ban$_2$) še *šar-rum u*$_2$*-pi-iš-šu-ma*	which from 1 *gur* grain 2 *ban* grain the king / calculated it and…

Lines one through three are just part of the greater statement of lines one through six, which describe how *Sîn-rāmā*'s rations were assessed and then accepted. The rest of the statement reads:

4	*a-na* e$_2$ sikil$^{?}$-li *ša id-di-nu*	gave to the e-sikilli$^{?}$,
5	še-ba ^{d}Sîn-*ra-ma*	(is) the grain ration of *Sîn-rāmā*
6	*ša i-na* aš-dub-ba^{ki} *am-ḫu-ru*	that I accepted in Ašdubba.

The author accepted grain revenue in Ašdubba, which shows that, unlike for interest statements, tax revenue reflected a current reality. It was not predictive but descriptive. However, AO 08493 was also a delivery text and this very same tax revenue was shown as an example of measurement inconsistency late in the reign of *Rīm-Sîn*. This is evident in lines seven through nine:

7	*i-di* anše-ḫi-a *a-bu-ul-lam*	The fee of the donkeys, gate,
8	*u*$_3$ *ṣi-ta-am a-pu-ul-ma*	and exit I paid.
9	1(aš) 1(bariga) 2(ban$_2$) gur *ša i-na* larsa[ki] *u*$_2$*-ša*[!]*-an-nu*	1 *gur* 1 *bariga* 2 *ban* which I remeasured in / Larsa

This text shows, first, the calculation of an estimated value in lines one through three, followed by the acceptance and thus implicit measurement of this value in lines four through six. Lines seven through nine show that there was an acceptable discrepancy with remeasurement after transportation to and arrival at Larsa and final receipt by the incoming institution. Even a descriptive statement of assessed values exhibits some uncertainty due to measurement inconsistency. The amount calculated and then measured is not the amount received. Thus, the hypothesis stated above is confirmed: an acceptable discrepancy had to be incorporated into estimated value because, once this value was received and remeasured, expected and received value could differ. But to fully understand this phenomenon better, it would help to understand how tax revenue calculation was carried out, as well as whether it differed from interest revenue calculation.

As stated above, contracts, as well as other economic texts, placed the main topic of a sentence or clause first, whether this reversed normal word order or not, and whether this affected the logical progression of the mathematical structure in this statement as well. Thus, while the statement found in lines one through three of AO 08493 itself reversed the order of calculation, this is because of the text's focus. It is an economic text in which a grain ration was being qualified by the source of this ration and then the way this ration was calculated. It is not a mathematical text in which the focus would be on the process and in which the sentence itself would exhibit a logical progression. In AO 08493, 1 *gur* 1 *bariga* 4 *ban* revenue is the focus of the statement found in lines one through six. It is qualified by line 2, 'the revenue of 20 *gur* grain', which in turn is further qualified by the statements in lines 3 and 4, 'which from 1 *gur* grain 2 *ban* grain the king calculated it and gave to the e-sikilli'. While the statement does describe a mathematical process, this process is not the goal of the statement. It is instead a part of an economic statement for which focus is on the result. The process is only a description. Thus, the statement of lines one through six can be paraphrased as follows (not to be confused with a translation):

> The king calculated the revenue of 20 *gur* grain (at a rate of) 1 *gur* grain (produces) 2 *ban* (revenue), (to produce) 1 *gur* 1 *bariga* 4 *ban* grain, and gave it to the e-sikilli as the grain ration of *Sîn-rāmā*, which I accepted in Ašdubba.

This paraphrase shows that revenue in the form of a tax was calculated out of 20 *gur* of grain. While this tax is collected on behalf of the e-sikilli, it is allocated to the grain rations for *Sîn-rāmā*.

The rate here is used differently from the interest rate stated in A.26371. In A.26371, the rate is 1 *bariga* per 1 *gur* while here the rate is 2 *ban* per 1 *gur*. An addition is implied with A.26371 while the rate in AO 08493 implies a subtraction.

The statement in AO 08493, then, works as follows: first, all quantities mentioned were probably transformed into SPVN.

20 *gur* → *1:40* (table of capacity)
1 *gur* → *5* (table of capacity)
2 *ban* → *20* (table of capacity)

Once transformed, if transformation took place, calculation of the tax revenue rate was probably carried out. This was described in a subordinate clause found in line 3 of AO 08493, 'from 1 *gur* grain 2 *ban* grain', that is, out of every *gur* of grain 2 *ban* would be subtracted. The reciprocal of 5, which corresponds to 1 *gur* in the revenue statement in line 3, is found to be 12. This is multiplied by 20, corresponding to 2 *ban* of the revenue statement in line 3, which produces a tax revenue rate of 4.

the reciprocal of *5* is $\underline{12}$
$\underline{12} \times \mathit{20} = \underline{4}$

Next, the principal amount in AO 08493, 1:40 corresponding to 20 *gur* grain in line 2, is multiplied by 4, the tax revenue rate, to produce 6:40, the revenue.

$1{:}40 \times \underline{4} = 6{:}40$

This is similar to VAT 08521 where 12, the interest rate, is multiplied by the principal, 8:20, to produce the interest, 1:40. After computation, 6:40, the revenue for AO 08493, is transformed into 1 *gur* 1 *bariga* 4 *ban* seen in line 1 of AO 08493:

6:40 → 1 *gur* 1 *bariga* 4 *ban* (table of capacity)

There are no mathematical texts describing tax rates and revenue calculations as witnessed by AO 08493.[5] AO 08493 differs from VAT 08521 in how the rate used to produce revenue was computed, which could be due to the measurement value used to define the rates. In VAT 08521, the standard chosen to define the rate is 1 *mana*, which transforms to SPVN 1, while in AO 08493 it is 1 *gur*, which transforms to SPVN 5. The author of VAT 08521 bypassed the need to compute an interest rate by defining the principal as a number that transforms into 1 in SPVN: 12 *gin* is one fifth of one *mana* so that, to compute total interest from principal, the author only needed to multiply by 5, the reciprocal of 12. To compute the total principal out of interest, the author only needed to multiply by 12. This is not the case with AO 08495. If the author of this text calculated using SPVN, he would have needed to multiply the tax statement 2 *ban*, which transformed to SPVN 20, by 12, the reciprocal of 5, to produce the tax rate at 1 *bariga*, the SPVN transformation of 1. However, this relies on the assumption that the author calculated in SPVN.

[5]However, see statements 6–11 of YBC 04698, which is studied in Middeke-Conlin and Proust (2014) for calculations with profit.

First, under this hypothesis, while both rates would have been computed differently, this was to produce a value relative to the SPVN number 1. This allowed calculation of revenue to be calculated in the same way in both VAT 08521: in AO 08493 and VAT 08521, the principal was multiplied by revenue or interest rate to produce the total revenue. Second, interest calculations were presented in the course of some scribal curriculum, as is suggested by texts like VAT 08521 from Uruk. Note also that interest calculation is present in Larsa's advanced education with AO 06770 problem 2, although this problem deals with what seems to be compound interest, while the procedure is incomplete and thus not presented here.[6]

1 *gur* seems to be an important base when calculating revenue as well as change rates. 1 *gur* defines both interest rates in YBC 04698. The rate in A.26371 is '1 *bariga* per 1 *gur*'. 1 *gur*, along with 2 *ban*, defines the rate calculation in AO 08493. In addition, 1 *gur*, along with 3 *ban* 5 *sila*, defines the change rate in LB 1075 and, with 3 *ban* 3 1/3 *sila*, defines the change rate in YBC 04265. This is because both revenue rates and change rates were used to assess value and produce a portion of that value to be added or subtracted from the value. With interest rates, revenue is an amount of growth. With tax rates, revenue is an amount to be paid on the item taxed. With change rates, the portion is a growth or decrease compared to a previous measurement, whether this is simply a reassessment of value or a change in standard. All are portions of value, and all rely on a measurement. Interest, on the other hand, is based on a full measurement of the principal at withdrawal, tax revenue rates and change rates would only require a sample measurement to take place in order to assess value. Indeed, with a tax rate, it can be suggested that a sample rate is preferred over a full assessment because the goal is only to assign value, while a full measurement could be expensive. Thus, revenue rates and change rates would be computed in the same manner and assessment would be similar. The choice of *gur* to define these rates may have been dictated by a customary sack size that amounted to how much one man could carry, as pointed out in Sect. 7.1.3.

In any event, the change rate and standard in YBC 04265, authored by *Nabi-Šamaš* B, could offer evidence that calculation of revenue was in SPVN, even if a sample was in *gur*. The change rate described in line 4 is 1 *gur* for every 3 *ban* 3 1/3 *sila*. The standard vessel used to qualify this change rate is stated in line 5 as the '1 *ban* standard vessel'. As stated in Sect. 7.1.3, this shows that a sample measurement probably took place and that it was carried out using the new standard to define this relationship. This would be enough of a qualifier if conversion was carried out by multiplying measurement values and not SPVN. However, the standard used to evaluate the conversion is described in line 3 as '1 *bariga* 6 2/3 *sila*'. That is, the old *bariga* standard vessel was stated as equal to 1 *bariga* 6 2/3 *sila* of the new *bariga* standard vessel. To produce this, *Nabi-Šamaš* had to divide 3

[6]Cf. Goetze (1945: 147–148) for its attribution to group 1 of Larsa. See Neugebauer (1935–1937: II 37–42 and III 62–65) for this text. See also VAT 08528, YBC 04669 problem B 11 and YBC 04698 statements 1 and 2 for additional interest problems.

ban 3 1/3 *sila* by 5 in order to show the growth rate at *bariga*, and then append this to the *bariga*. The reason for this extra and seemingly unnecessary statement is transparency—the author of this text was calculating in SPVN and while he assessed a sample measurement of grain at *gur*, he calculated at *bariga* because it transformed to SPVN 1. By choosing to calculate at *bariga*, *Nabi-Šamaš* greatly simplified calculation only if he was calculating by means of SPVN. Thus, in this example conformity is established out of custom. From this, it can be suggested that revenue and change rates were typically computed using SPVN, even if the standard for a sample measurement of grain was customarily set at *gur*.

Taxes, change rate estimations and then standard conversions were all calculated in a similar manner as interest calculations learned in the course of the scribal education. Indeed, tax and change rates were constructed in the same manner, while conversion rates were constructed out of change rates. There seems to be an economization of mathematical practice between professional environments that build on algorithms or their components as witnessed in mathematical texts and the advanced scribal education—tax and change rates, as well as conversion rates, had the same basic procedure as interest rates. The same basic design is witnessed in multiple environments. We can wonder then, if the elementary education produced building blocks of calculation, the metrological and numerical tables as discussed in Chap. 5, did the advanced education produce building blocks of practice that were built upon in the same way? That is, were basic tools and algorithms designed that could be implemented across professional environments and incorporated into other algorithms?

If this hypothesis could be proven, it would explain why, for instance, there is no trace of change rate estimations, conversions or taxes in the scribal curriculum. Formally presenting these would have been redundant because of their similarity to interest calculations. If these were used in an advanced education, whether in a classroom or a professional setting, one can hypothesize some form of commentary went with the presentation of algorithms in the advanced education, in this case commentary presenting value assessment and perhaps proportionality through a specific kind of assessment, i.e. interest.

8.2 Equivalencies

Equivalencies are not new to the Old Babylonian period, as Englund makes clear. Englund (2012: 435) notes over 2560 attestations of silver equivalencies and 4000 attestations of grain equivalencies, as well as other mediums of equivalencies, in Ur III period texts.[7] Equivalency rates were produced by eight different scribes studied here who were active from near the beginning of Larsa's independent history and

[7]For a recent discussion of grain and silver equivalencies in the Ur III period, see Cripps (2017).

Table 8.1 Texts showing equivalency rates

Text and line	Scribe	Date
YBC 04224	Scribe A	*Gungunum*
NBC 08014	*Ilšu-ibbišu*	*Sîn-iddinam* year 06
YBC 07473	*Itti-Sîn-milki*	*Rīm-Sîn* year 04
AO 06760	*Ubar-Šamaš*	*Rīm-Sîn* year 02
Ashm 1932-378	*Šēp-Sîn* A	*Rīm-Sîn* year 21
HE 111	*Šēp-Sîn* B	*Hammu-rābi* year 40
YBC 07744	*Sîn-muštāl*	*Hammu-rābi* year 41
AUAM 73.2672	*Aḫiya*	*Samsu-iluna* year 07

working through its loss of independence at the hands of *Hammu-rābi* of Babylon and almost to the time of Larsa's destruction in *Samsu-iluna*'s reign (Table 8.1).

It was suggested in Chap. 5 that estimation was the goal of equivalency calculations, where one good, presented in one system, was assessed by means of another good, usually silver or grain, or in another system. An estimation, as used here, is a calculated approximate value. As stated in Chap. 5, an equivalency did not necessarily imply that the medium of assessment, such as silver or grain, was present or even available. Also in Chap. 5, it was suggested that these equivalency rates were often, though not always, formed around a few reciprocal pairs when transformed to SPVN so that calculation may have been based on SPVN numbers and not measurement values. These SPVN numbers and reciprocal pairs suggested a kind of conformity or use of established rates or numbers set by social custom or economic conventions. Indeed, so far in this chapter the use of rates, whether conversion, change, tax or interest rates, was based on numbers found on the standard SPVN multiplication tables and, when division was required, multiplication incorporated a few SPVN reciprocal pairs typical of the standard reciprocal tables. In this way, these conformed equivalencies were made easily recognizable and manipulated by any scribe who would encounter them if that scribe was educated in an iteration of the scribal curricula presented in Chap. 2. How were equivalency rates computed? Were there any mathematical texts in which equivalency rates were examined? Were there discrepancies associated with equivalencies? How did scribes cope with these discrepancies?

8.2.1 Do Equivalencies Reflect a Calculation?

To answer these questions, it will help to understand terms used to qualify these rates. The words sa$_{10}$, kar or ganba each serve to qualify equivalency rates. These words are often used explicitly in the equivalency statements so that in lines 7 and 8 of YBC 07473 an equivalency is qualified by sa$_{10}$:

7	4(u) udu-nita$_2$ s[a$_{10}$] 1(diš) udu-e 1(diš) gin$_2$-ta	40 rams (according to the) price 1 *gin* per 1 sheep
8	ku$_3$-bi 2/3 ma-na	its silver 2/3 *mana*

As a verb, sa$_{10}$ can be translated as 'to buy', while with the ablative prefix -ra-, it is translated as 'to sell'. This verb implied a procedure whereby one item, written as a standard measurement value, was assessed by means of another item, written in another measurement value. This was then an equivalency statement as Neugebauer and Sachs (1945: 97) first suggested. Here, the nominalized form is translated as 'price' and refers to a physical transaction where an exchange was made.[8]

In AO 06760 lines 18 and 19 an equivalency is also expressed, this time qualified by kar:

18	4 gin$_2$ ku$_3$-gi kar-bi 9 gin$_2$-ta-am$_3$	4 *gin* gold, its fixed rate 9 *gin* (silver) per (*gin* gold)
19	ku$_3$-bi 1/2 ma-na 6(diš) gin$_2$	its silver 1/2 *mana* 6 *gin*

kar, as understood here, is viewed as a rate defined by the local merchant community, or *kārum*, and is thus a fixed rate in which the medium used to evaluate a good, often silver, need not be present (Middeke-Conlin forthcoming a). It can state both an in-kind or in-silver fixed rate. This is played out in AO 08464 where kar is clearly used to describe both in-kind and in-silver fixed rates.

In YBC 07744 lines 7 and 8 ganba qualifies an equivalency:

7	4(aš) gur sim^{ku6} ganba 2(bariga) 3(ban$_2$)-ta-am$_3$	4 *gur* simma fish going rate 2 *bariga* 3 *ban* per (*gin* / silver)
8	ku$_3$-bi 8(diš) gin$_2$	its silver 8 *gin*

ganba, Akkadian *maḫīrum*, is often translated as 'tariff, price equivalent, rate' (CAD M 1: 92). It is employed to describe unofficial prices of goods that exhibit some fluctuation (Middeke-Conlin forthcoming a) and, in mathematical texts describes a rate for a quantity of items per one *gin* silver (in-kind rate) or a quantity of silver per one unit of an item (in-silver rate, see Middeke-Conlin and Proust 2014: Sect. 2.4). The latter rate, an in-silver rate, is seen in NBC 08014, where the rate is described in terms of an amount of silver per *gin* gold while in YBC 07744 the former is witnessed, where counted fish are evaluated per *gin* silver. The variability of rates is expressed especially in HE 111: 5 and 8, where 'ganba a-ḫi-a' translates to 'different going rates'.

Each variety of rate is part of an equivalency statement: the first example describes a counted quantity of sheep, the second, gold assessed by weight, and the third example a quantity of fish assessed by capacity. In each example, this in-kind value is followed by a rate statement and an equivalent value, often in silver or

[8]For more on this word, see Middeke-Conlin and Proust (2014: § 2.2).

grain. The rate statements are important because they state how the equivalency was calculated. YBC 07473 lines 7 and 8 help explain how these rates worked: because one sheep is the equivalent of one *gin* silver, 40 sheep are equivalent to 40 *gin* weight in silver, which amounts to 2/3 *mana*, or stated otherwise:

40×1 *gin* = 2/3 *mana*

The –e suffix after sheep (udu) and –ta after 1 *gin* allow the reading 'from 1 *gin* to 1 sheep' and thus presents the statement above (cf. Middeke-Conlin forthcoming a). This is probably implied in AO 06760 lines 18 and 19 where only the ablative –ta suffix is appended to an in-silver rate as well as YBC 07744 lines 7 and 8 where it appears appended to a statement of the in-kind rate so that 1 *gin* silver value was probably implied with the latter and 1 *gin* in-kind value was implied with the former. Thus, the –ta suffix in AO 06760 can be read as '…per (*gin* gold)' and in YBC 07744 '…per (*gin* silver)'.[9]

Not all texts include complete formulas. For instance, in AO 08464 the –ta suffix is lacking in each rate. Lines 2 and 3 read as follows:

2	8(diš) gin$_2$ ku$_3$-gi kar 4(diš) gin$_2$	8 *gin* gold fixed rate 4 *gin* (per *gin* gold)
3	ku$_3$-bi 1/2 ma-na 2(diš) gin$_2$	its silver 1/2 *mana* 2 *gin*

The –ta suffix was certainly implied here, although it is not explicitly written, even if 'kar' is written. In addition, some equivalencies add an additional step. In YBC 07744, the first two rates compute an equivalency of fish from weight to counted quantities and then assess the counted quantity in silver. Thus, two equivalencies are found: the counted equivalent of fish initially assessed by weight, and then the value of this counted equivalent in silver weight. Lines 1 through 3 read:

1	3(u) 5(aš) gu$_2$ ⸢dig⸣-ku$_6$ ša$^!$ 3(diš) šu-ši-ta$^!$-am$_3$	35 *gu* softened-fish which are 3 sixties per (*gu* fish)
2	ganba 4 šu-ši-ta-am$_3$	going rate 4 sixties per (*gin* silver)
3	ku$_3$-bi 1/3 ma-na 6(diš) gin$_2$ igi 4(diš)-	its silver 1/3 *mana* 6 *gin* one-4$^{\text{th}}$
	/ gal$_2$	

Note that the initial equivalency lacks the three terms above for an equivalency: ganba, kar or sa$_{10}$. This is possibly because this initial equivalency, used to produce a count of fish, is only one step in producing a silver equivalency for these fish.

[9]For the –ta suffix in the Ur III period silver accounts, see Snell (1982: 39). For its use in an Old Babylonian mathematical text, YBC 04698, see Middeke-Conlin and Proust (2014: Sect. 2.1).

8.2.2 Equivalencies in the Mathematical Tradition

Equivalency rates, used to calculate equivalent values in economic texts, were also expressed in the mathematical tradition, albeit with different goals in mind. Tabular texts such as MS 2830 were probably exploited in a later Old Babylonian mathematical text, YBC 04698, especially statement 3 (see Middeke-Conlin and Proust 2014: Sect. 3 and below, this section). YBC 04698 presents a series of problems that, among other things, possibly explore the strength of tables like those on MS 2830 in the framework of economic problems. While these texts do not reflect economic reality and thus their practicality is limited, the tables found on MS 2830 and the problems that exploited these tables, like statement 3 of YBC 04698, may have formed a conception of exchanges and equivalent values that transferred into professional settings, just as VAT 08521, problem 1 prepared the student to calculate interest in a professional setting as seen above.

MS 2830 states 1 *gin* silver (1(diš) gin$_2$ ku$_3$-babbar), probably in reference to column III, suggesting the evaluation of commodities in silver was its goal. YBC 04698 probably exploited tables such as those found on MS 2830 in pursuit of economic problems without explicitly mentioning these tables. If true, then lack of a table or another tool does not discount the use of this table or tool to carry out calculation in a text.

While MS 2830 and other similar texts do not present economic reality, this does not disqualify their utility in an economic environment. This utility cannot be in the entire algorithm as it is set up in YBC 04698, which, as stated, does not reflect economic reality. However, these texts did build on already existing practices based in reality. Indeed, as stated above, there may have been a tendency to economize practices so that tools produced or representative of one environment could be exploited in another environment. This led to the hypothesis that these algorithms presented building blocks of calculation to be implemented in other, similar environments. This may be the case with MS 2830 and other tables like it. The complete algorithm did not present reality, but it did build on reality and does reflect practice to an extent.

In so far as equivalency calculations are concerned, utility could have been present in the relationships between columns in tables like MS 2830. The format of MS 2830 and other similar tables allowed the assessment of value between two dissimilar goods such as oil and silver in YBC 04698 statement 3, or fish and silver in YBC 07744 lines 7 and 8. Thus, this relationship is evident in MS 2830: column III, the value of silver, multiplied by column I, the in-kind rate, produces column IV, the in-kind value. On the other hand, column IV, the in-kind value, multiplied by column II, the in-silver rate, produces column III, the in-silver value. Numbers in column II and column I, the equivalency rates, are reciprocal pairs. This is summed up in Table 8.2.[10]

[10]As presented in Middeke-Conlin (forthcoming a), following Middeke-Conlin and Proust (2014: Sect. 3).

Table 8.2 Interpretation of MS 2830 § 2a

1 *gin* → 1 (Table of weight)				
Col.	I	II	III	IV
		Reciprocal of I	II × 28:48	I × III
	In-kind rate	In-silver rate	In-silver value	In-kind value
Good 1	1	1	28:48	28:48
Good 2	2	30	14:24	28:48
Good 3	3	20	9:36	28:48
Good 4	4	15	7:12	28:48
Sum		2:5	1	

Column I is the in-kind rate
Column II is the in-silver rate and the reciprocal of column I
Column III is the in-silver value and the product of column II multiplied by a coefficient. This coefficient is calculated out of the sum of column II and the assumption that the sum of column III is 1; thus, the coefficient is the reciprocal of 2:5, that is, 28:48
Column IV is the in-kind rate, the product of column I multiplied by column III

The variety of tables present on MS 2830, which probably represent problems of 'making equal', also provided a tool for assessment between dissimilar goods or even dissimilar metrological systems, so that equivalent values could have been estimated with this tool in mind. Indeed, it is difficult to see how this could have been missed by the ancient merchant if he practiced problems similar to the statements in YBC 04698 with tables like MS 2830 in mind. Thus, limited practical knowledge was probably attained in a professional environment by using tools that were originally useful for expressing an algorithmic relationship in an academic environment—the economization of practice hypothesized above. A similar relationship probably existed between values found on YBC 04698, the columns in MS 2830 and then values found in lines 7 and 8 of YBC 07744. An equivalency is made by means of a rate.

As stated above, contracts and other economic texts state the focus of a sentence or clause first, regardless of word order or logical succession in texts. Thus, for YBC 07744, lines 7 and 8, focus is on the in-kind value of 4 *gur* fish even if this would appear in the fourth column of tables such as those presented on MS 2830. However, immediately following this entry is the in-kind rate, which would appear in column I of a text like MS 2830, while its reciprocal, the in-silver rate, would appear in column II, and then the in-silver value stated in line 8 of YBC 07744 would be found in column III of the table. While focus is on the in-kind value, which appears first, the remainder of the text does present a logical succession as witnessed in MS 2830. Finally, only two numerical tables were needed to carry out calculation in YBC 07744, lines 7 and 8: the standard reciprocal table and the standard table of 20 or 24 as witnessed at Nippur (Table 8.3).

This last raises an important question. As seen above, SPVN was probably used with revenue, change, and equivalency rates. As suggested in Chap. 5, the scribe may have transformed all measurement values into SPVN when carrying out a

Table 8.3 Equivalency in YBC 07744 lines 7–8

7	4(aš) gur sim^{ku6} ganba 2(bariga) 3 (ban$_2$)-ta-am$_3$	4 *gur* simma fish going rate 2 *bariga* 3 *ban* per (*gin* /silver)
8	ku$_3$-bi 8(diš) gin$_2$	its silver 8 *gin*

In-kind value:
4 *gur* → *20* (table of capacity)
In-kind rate:
2 *bariga* 3 *ban* → *2:30* (table of capacity)
The reciprocal of *2:30* is $\underline{24}$
20 × $\underline{24}$ = *8*
In-silver value:
8 → 8 *gin* (table of capacity)
Possible SPVN numerical tables (as evident from Nippur): 2
Standard reciprocal table
Table of 20 or table of 24

multiplication. Can the texts themselves offer additional evidence for this? Did they transform measurement values into SPVN before calculating equivalencies?

8.2.3 Equivalencies and Discrepancies

A possible way to answer this is to ask, again, 'were there any discrepancies associated with equivalencies'? and then, 'were the scribes aware of these discrepancies'? If metrological transformation to SPVN took place, as hypothesized above, the in-kind rate, following calculation found on the tables of MS 2830 and as proposed for YBC 04698 statement 3, was then placed in column I and its reciprocal, the in-silver rate, was found and placed in column II. The in-kind value was placed in column IV while the product of column IV multiplied by the in-silver rate of column II is placed in column III, the in-silver value. To find in-silver value from an in-silver rate, such as the rate statement in AO 06760, lines 18 and 19, while less common, did not require the calculation of a reciprocal, one needed only to multiply in-kind value by the in-silver rate to produce in-silver value (Table 8.4).

Here, then, only one numerical table would have been necessary: the standard multiplication table of 4 or 9 as witnessed at Nippur. Most rates work perfectly in the texts. They act as they should and require little comment. However, YBC 04224, NBC 08014 and YBC 07473 show deviations from what is expected.

The discrepancy in YBC 04224's equivalency, found in lines 26 through 27, was briefly described in Chap. 6. The rate starts with the total of added quantities of sesame assessed by capacity and stated in lines 15 through 25. This total is stated in line 26 as 2 × 60 + 20 *gur*, although in reality 2 × 60 + 20 *gur* 7 *sila* is expected. The omission of 7 *sila* is probably intentional. Chap. 7 showed that the ancient scribes were aware of measurement inconsistency when it came to capacity, so that omission of lower values was a method to offset or limit potential error in a

Table 8.4 Equivalency in AO 06760, lines 18–19

18	4 gin_2 ku_3-gi kar-bi 9 gin_2-ta-am_3	4 *gin* gold, its fixed rate 9 *gin* (silver) per (*gin* gold)
19	ku_3-bi 1/2 ma-na 6(diš) gin_2	its silver 1/2 *mana* 6 *gin*

In-kind value:
4 *gin* → *4* (table of weight)
In-silver rate:
9 *gin* → *9* (table of weight)
4 × *9* = *36*
In-silver value:
36 → 1/2 *mana* 6 *gin*
Possible SPVN numerical tables (as evident from Nippur): 1
Table of 4 or table of 9

measured value. However, YBC 04224 is interested in silver values of expenditures, not sesame, so that an equivalency of this total needed to be found. As suggested in Chap. 6, the in-silver value matches the stated sesame value rather than the expected sesame value, so that it is clear the equivalency of silver was made after sesame values were added together and rounded down and not before. This is very important because it suggests the author actually calculated equivalent value; he was not dealing with actual silver but instead estimated silver (Table 8.5).

In YBC 04224, rounding up 7 *sila* to 1 *ban* would have produced a smaller discrepancy. Why didn't the author round up? If he rounded to offset measurement inconsistency, then it is likely he would have preferred to round down in order to produce a more certain value—this was suggested as the reason for truncation in Chap. 7. Thus, 7 *sila* was removed. This had the added benefit of simplifying multiplication because the author would have multiplied a more concise number after transformation from measurement value to SPVN. Thus, tables necessary to make this equivalency were reduced by truncation from 4 to 3. In addition, as pointed out in Chap. 6, if the equivalency had been made with the expected total of 2 × 60 + 20 *gur* 7 *sila*, the result would have been 14 *mana* 25 one-5th *še* (Table 8.6).

The entry one-5th *še* is not found on any metrological table and, as shown in Chap. 7, scribes had difficulty transforming values that were not found on the metrological lists and tables. Thus, with the equivalency in YBC 04224, truncation made much sense because it produced a more certain value, simplified calculation and simplified transformation. Chapter 7, while discussing measurement inconsistency, showed the importance of truncating value to increase certainty, while Chap. 5 established that numbers were chosen to simplify calculation. Can further evidence be found that scribes chose values or numbers because they simplified transformation to and from SPVN using the metrological tables memorized in the elementary scribal education?

The equivalency made in NBC 08014 lines 1–3 may help to answer this question. The rate given in this equivalency is defined as 'ganba-a 10 gin_2-ta-am_3'.

Table 8.5 Equivalency in YBC 04224, lines 26–27

26	šu-nigin 2(geš$_2$) 2(u) gur še-giš-i$_3$	total 2 × 60 + 20 *gur* sesame
27	kar-bi 5(ban$_2$)-ta ku$_3$-bi 1(u)4(diš) ma-na	its fixed rate 5 *ban* per (*gin*), its silver 14 *mana*

In-kind value:
2 × 60 + 20 *gur* → *11:40* (table of capacity)
In-kind rate:
5 *ban* → *50* (table of capacity)
The reciprocal of *50* is 1:12
1:12 × *11:40* = *14*
In-silver value:
14 → 14 *mana* (table of weight)
Possible SPVN numerical tables (as evident from Nippur): 3
Standard reciprocal table
Table of 11
Table of 40

Table 8.6 Equivalency of expected total sesame values in YBC 04224, lines 26–27

26	šu-nigin 2(geš$_2$) 2(u) gur še-giš-i$_3$	total 2 × 60 + 20 *gur* sesame
27	kar-bi 5(ban$_2$)-ta ku$_3$-bi 1(u)4(diš) ma-na	its fixed rate 5 *ban* per (*gin*), its silver 14 *mana*

In-kind value:
2 × 60 20 *gur* **7 *sila*** → *11:40:***07** (table of capacity)
In-kind rate:
5 *ban* → *50* (table of capacity)
The reciprocal of *50* is 1:12
1:12 × *11:40***:07** = 14**:0:8:12**
In-silver value:
14 → 14 *mana* **25 one-5th *še*** (table of weight)
Possible SPVN numerical tables (as evident from Nippur): 4
Standard reciprocal table
Table of 11
Table of 40
Table of 7

If this rate was used, then either the silver value in line 3 is rounded down one-6th *gin*, or the amount in gold rounded 27 *še* up by 3 *še* (Table 8.7).

The difference in gold would be 0.457 per cent, while the difference in silver would be 0.455 per cent. Rounding up from 3 1/2 *gin* 27 *še* gold to 3 2/3 *gin* seems more likely in this example than rounding down from 1/2 *mana* 6 2/3 *gin* silver to 1/2 *mana* 6 1/2 *gin*. While the per cent difference is less, the difference in observable values is greater. That is, a one-6th *gin* (equivalent of 30 *še*) difference is more easily witnessed than 3 *še*. This is important when a five to six per cent deviation in *gin* weight was considered acceptable, as noted in Chap. 7. This would also allow a logical order in the text: silver value precedes gold value.

Table 8.7 Equivalency in NBC 08014, lines 1–3

1	⸢1/2⸣ ma-na 6 1/2 gin_2 ku_3-babbar	1/2 *mana* 6 1/2 *gin* silver
2	sa_{10} 3 2/3 gin_2 ku_3-gi	price of 3 2/3 *gin* gold
3	ganba-a 10 gin_2-ta-am_3	going rate is 10 *gin* per (*gin* gold)

In-kind value:
3 2/3 *gin* → *3:40* (table of weight)
Rate:
10 *gin* → *10* (table of weight)
The reciprocal of *10* is <u>6</u>
3:40 × <u>6</u> = **36:40**
In-silver value:
36:40 → 1/2 *mana* 6 2/3 *gin* (table of weight)
Possible SPVN numerical tables (as evident from Nippur): 2
Standard reciprocal table
Table of 6
or
36:30 × *10* = *3:***39**
In-silver value:
3.**39** → 3 **1/2 *gin* 27 *še* (table of weight)**
Possible SPVN numerical tables (as evident from Nippur): 1
Table of 10

As stated above, in economic texts sentence and statement structures are arranged by focus, not by calculation, so that placing silver before gold suggests that a silver equivalent to purchase gold was the aim of the text, and not the opposite. The word used to describe this equivalency rate is *ganba*, a price that can fluctuate with the market and therefore reflects reality. In addition, this is described as the 'receipt of *Ilšu-ibbišu*' in line 4, suggesting that *Ilšu-ibbišu* actually received the silver and not the gold weight. The gold value was probably the calculated value, that is, how much would be purchased from the silver value in line 1, and so serves to qualify the expenditure in silver. Here, then, silver is an observed reality, while gold is an estimation. AO 08014 does not express a completed purchase in silver, only a receipt of silver for the future purchase of gold.

Finally, rounding up to 2/3 *gin* gold makes more sense if the calculation was in SPVN. By rounding 3:39 up by 1 to 3:40 the author simplified transformation between SPVN and measurement values. The author only needed to transform SPVN 3 to 3 *gin* and 40 to 2/3 *gin*, rather than SPVN 3 to 3 *gin*, 30 to 1/2 *gin*, and 9 to 27 *še*. The author transforms two parts, not three.[11] Whether he transformed 36:30 to 1/2 *mana* 6 1/2 *gin* or 36:40 to 1/2 *mana* 6 2/3 *gin*, the author would have transformed three different parts: 30 to 1/2 *mana*, 6 to 6 *gin* and either 30 to 1/2 *gin* or 40 to 2/3 *gin*. This, then, could be understood as rounding up of 1 in SPVN rather than 3 *še* to simplify transformation. Transformation can then be understood as a kind of calculation in the mind of this scribe—one that could be simplified through

[11]This is according to the metrological table of weights from Nippur, for which see Chap. 2.

rounding. To confirm that simplifying transformation could be a concern in rounding numbers in both YBC 04224 and NBC 08014, it would help to find an economic text in which acceptable measurement values were probably defined by metrological tables.

The equivalency found in YBC 07473 lines 13–14 is especially interesting because it offers evidence for the use of SPVN in calculation, for how a scribe calculated with non-regular rates and rounded based on the metrological tables.[12] YBC 07473 is a balanced account stating capital accrued over five official years, *Warad-Sîn* year twelve to *Rīm-Sîn* year three, with the account itself dated to *Rīm-Sîn*'s fourth year in power. The scribe is either *Itti-Sîn-milki*, merchant overseer of *Zarbilum* near Larsa, or a scribe in his employ. Capital takes the form of wool, sheep and sesame in this text and each is made equivalent to a silver value for record-keeping purposes. Lines 13–14 present the equivalent of 2 × 60 *gur* sesame, stated at 5 1/3 *mana* 7 *gin* one-4th 5 *še* silver, and provided a rate of 1 *bariga* 5 *ban* per *gin* silver. The problem with this rate is that 1 *bariga* 5 *ban* silver does not produce 5 1/3 *mana* 7 *gin* one-4th 5 *še* silver out of 2 × 60 *gur* sesame. When transformed to SPVN, the reason for this becomes apparent: 1 *bariga* 5 *ban* transformed to 1:50, a non-regular number (Table 8.8).

1:50 does not appear in the standard reciprocal table. However, the author of YBC 07473 would have been able to tell that the factors of 1:50 were 10 and 11 based on his familiarity with the multiplication tables learned in his elementary education (1:50 = 10 × 11).[13] 10 is the reciprocal of 6 and is found on the standard list. 11, however, is a non-regular number and thus required an approximate reciprocal. How could an approximate reciprocal have been produced? M 10, a type IV practice tablet, presents the approximate reciprocals of 7, 11, 13, 14 and 17 as well as whether this approximation would produce a deficit (*sītum*) or an excess (diri). The goal of M 10 was to find acceptable approximate reciprocals to non-regular numbers and then the error these approximations would produce. Thus, the author produced two approximate reciprocals to 7. First, he produced 8:34:16:59, which would produce a deficit because 7 multiplied by 8:34:16:59 yields 59:59:58:53. However, the author produced another approximate reciprocal to 7, that is 8:34:18, which would produce an excess because 7 multiplied by 8:34:18 yields 1:0:0:6. These approximate reciprocals would be substitutes for the actual, undetermined reciprocal, so that each approximate reciprocal is a rounded value.

It is difficult to tell whether M 10 is the result of a master or a student practicing with numbers. Sachs (1952: 153) notes that the reverse of the tablet contains several isolated wedges which would have resulted from erasures and re-use, while the quality of writing suggests the scribe was less well versed. However, as Sachs also

[12]Much of this argument is made in Middeke-Conlin (forthcoming a).

[13]If this was not obvious to him, evidence exists for reciprocal extraction by means of factorization exercises, such as UET 6/2 295 (Appendix 1.B). However, as Christine Proust points out, it hardly seems necessary for a scribe familiar with the numerical tables to have required the use of this form of exercise to assess the factors for 1:50 (private email).

Table 8.8 Equivalency in YBC 07473, lines 13–14

13	2(geš$_2$) gur še-giš-i$_3$ kar-bi 1 (bariga) 5(ban$_2$)-ta	2 × 60 *gur* sesame its fixed rate (is) 1 *bariga* 5 *ban*/per (*gin* silver)
14	ku$_3$-bi 5(diš) 1/3 ma-na 7(diš) gin$_2$igi-4(diš)-gal$_2$	its silver (is) 5 1/3 *mana* 7 *gin* one-4th 5 *še* 5(diš) še

In-kind value:
2 × 60 *gur* → *10* (table of capacity)
In-kind rate:
1 *bariga* 5 *ban* → *1:50* (table of capacity)
The reciprocal of *1:50* is ?
? × *10* = *5:27:16:40*
In-silver value:
5:27:16:40 → 5 1/3 *mana* 7 *gin* one-4th 5 *še* (table of weight)

points out, teachers also wrote texts in schools (*ibid.*: 153). M 10 does not name an author, but the nature of the text shows it to be an exercise. Mistakes in stating deficit when an excess is expected occur in three separate reciprocal exercises, 11, 14 and 17, suggesting that the author was genuinely experimenting with these numbers so that, whether student or master, the author had difficulty on this point. The author of M 10 believed the numbers would produce an error below 1 rather than above 1.

Re-use of the tablet M 10 suggests it was produced in a teaching environment, whether the work of a student or master. Because 1:50 exists as a fixed rate provided by the local *kārum* or merchant community, it can be surmised that training with non-regular numbers, at least to a limited degree, was expected of a merchant in the town of *Zarbilum* where *Itti-Sîn-milki* was active. This, coupled with the existence of M 10, produces the possibility that non-regular reciprocals were learned in at least some scribal centers, whether the author of M 10 was a student or a master.[14] This helps to explain the approximate reciprocal of 1:50. The factors of 1:50 may have been extracted based on familiarity with multiplication tables. 6, the reciprocal of the factor 10, multiplied by 5:27:16:22, an approximate reciprocal of the factor 11, produced 32:43:38:12.

6 × 5:27:16:22 = 32:43:38:12

However, 32:43:38:12 multiplied by 10 does not produce 5:27:16:40 but 5:27:16:22 which transformed into 5 1/3 *mana* 7 one-4th *gin* 4 *še* and left a remainder of a little above one twelfth *še*. The lowest value on the extant metrological tables and lists from Larsa is 1/2 *še*. As seen in Chap. 7, students and masters had difficulty transforming measurement values outside of the metrological lists to and from SPVN. It is thus likely that the author of this text wanted to round one way or another and chose to round up.

[14]Note also YBC 10529 in Neugebauer and Sachs (1945: 16), a further exercise in the approximations of reciprocals, presumably from 1 to 1:20 and including non-regular numbers, although the obverse is broken.

A look at M 10 again may help explain this. The author of M 10 was experimenting with the reciprocals of non-regular numbers as well as how these numbers acted during multiplication. He was examining the error these numbers would produce, whether a deficit or an excess after calculation, and he wrote 'deficit' next to the approximate reciprocal of 11 rather than the expected 'excess'. This shows he somehow made a mistake with this relationship, whether it was simply a temporary lapse in judgment limited to his work on tablet M 10 or a fundamental misunderstanding of the relationship itself. It is not too difficult to suggest that the author of YBC 07473 could have made a similar mistake, whether this mistake was limited to a lapse while producing YBC 07473 or a more fundamental misunderstanding. If so, then in order to offset round-off error, the author of YBC 07473 would have mistakenly rounded 5:27:16:22 up to 5:27:16:40 instead of down. But why up to 5:27:16:40 and not 5:27:16:30?

The answer could be that the author of YBC 07473 was familiar with the metrological tables learned during elementary scribal education. Chapter 2 showed that the metrological lists and tables produced a conception of the measurement values in which shifts occurred between numerical values and measurement units as well as repetitions of SPVN cycles. Each measurement value on these tables was associated with a SPVN number and these numbers were each located in repeated cycles of 1 through 59. The SPVN numbers were floating numbers while the measurement values were concrete. Thus, if the author rounded based on measurement values, he would round by shifts in measurement values. 4 and one-12th *še* should round up to 4 1/2 *še*. However, it rounds up to 5 *še* on YBC 07473. Ashm 1923-410, a table of weights from Larsa presented in Chap. 2, showed these entries:

1/2 *še* silver	10
1 *še*	20
1 1/2 *še*	30
2 *še*	40
2 1/2 *še*	50
3 *še*	1
4 *še*	1:20
5 *še*	1:40
6 *še*	2

A cycle shift is visible between 2 1/2 *še*, corresponding to 50 in SPVN, and 3 *še*, corresponding to 1 in SPVN. 1/2 *še* appears below this shift and not after it. However, 1:20 corresponding to 4 *še* and 1:40 corresponding to 5 *še* appear after this shift in the cycle. It seems that the author of YBC 07473 rounded up from 5:27:16:22 to 5:27:16:40 because there was a jump between 1:20 or 4 *še* and 1:40 or 5 *še*. 1/2 *še* was excluded because it did not belong to the same SPVN cycle as learned in school. The author simply reverted to what he learned in the very basic elementary education as described in Chap. 2.

Table 8.9 Equivalency calculations for YBC 07473, lines 1–11

<table>
<tr><td>1</td><td>2(geš$_2$) gur še-giš-i$_3$</td><td>2 × 60 gur sesame</td></tr>
<tr><td>2</td><td>kar-bi 1(bariga) 1(ban$_2$) 5(diš) sila$_3$-ta</td><td>its fixed rate (is) 1 bariga 1 ban 5 sila per (gin silver)</td></tr>
<tr><td>3</td><td>ku$_3$-bi 8(diš) ma-na</td><td>its silver (is) 8 mana</td></tr>
<tr><td colspan="3">Equivalency lines 1–3:
In-kind value:
2 × 60 gur → 10 (table of capacity)
In-kind rate:
1 bariga 1 ban 5 sila → 1:15 (table of capacity)
The reciprocal of 1:15 is $\underline{48}$
10 × $\underline{48}$ = 8
In-silver value:
8 → 8 mana (table of weight)
Possible SPVN numerical tables (as evident from Nippur): 2
Standard reciprocal table
Table of 10 or 48</td></tr>
<tr><td>4</td><td>1(u) gu$_2$ siki-gin kar-bi 1(u) ma-na-ta</td><td>10 gu average wool its fixed rate (is) 10 mana per/(gin silver)</td></tr>
<tr><td>5</td><td>ku$_3$-bi 1(diš) ma-na</td><td>its silver (is) 1 mana</td></tr>
<tr><td colspan="3">Equivalency lines 4–5:
In-kind value:
10 gu → 10 (table of weight)
In-kind rate:
10 mana → 10 (table of weight)
The reciprocal of 10 is $\underline{6}$
10 × $\underline{6}$ = 1
In-silver value:
1 → 1 mana (table of weight)
Possible SPVN numerical tables (as evident from Nippur): 2
Standard reciprocal table
Table of 10 or 6</td></tr>
<tr><td>7</td><td>4(u) udu-nita$_2$ s[a$_{10}$] 1(diš) udu-e 1 (diš) gin$_2$-ta</td><td>40 rams (according to the) price 1 gin per 1 sheep</td></tr>
<tr><td>8</td><td>ku$_3$-bi 2/3 ma-na</td><td>its silver (is) 2/3 mana</td></tr>
<tr><td colspan="3">Equivalency lines 7–8:
In-kind value:
40 udu-nita$_2$ → 40
In-kind rate:
1 udu → 1
In-silver rate:
1 gin$_2$ → 1 (table of weight)
40 × 1 = 40
In-silver value:
40 → 2/3 mana (table of weight)
Possible SPVN numerical tables (as evident from Nippur): 1
Table of 40</td></tr>
</table>

(continued)

Table 8.9 (continued)

10	2(geš$_2$) gur še-giš-i$_3$ kar-bi 2 (bariga)-ta	2×60 *gur* sesame its fixed rate (is) 2 *bariga* per (*gin*/silver)
11	ku$_3$-bi 5(diš) ma-na	its silver (is) 5 *mana*
Equivalency lines 10–11: In-kind value: 2×60 *gur* $\rightarrow$ *10* (table of capacity) In-kind rate: 2 *bariga* $\rightarrow$ *2* (table of capacity) The reciprocal of *2* is 30 *10* $\times$ 30 = 5 In-silver value: *5* $\rightarrow$ 5 *mana* (table of weight) Possible SPVN numerical tables (as evident from Nippur): 2 Standard reciprocal table Table of 10 or 2		

The remaining equivalencies in YBC 07473 work as expected (Table 8.9). The in-kind values are interesting for the purposes of this study. Other than rams in line 7, these items, when transformed into SPVN, express some conformity. Sesame, expressed with capacity in lines 1, 10 and 13, as well as wool, expressed with weight in line 4, all transform into 10 in SPVN. Only sheep in line 7 deviates from this. But, as pointed out in Middeke-Conlin (forthcoming a), this corresponds to *Rīm-Sîn*'s first year as king and so may mark a special expenditure. Thus, SPVN could present uniformity, and this uniformity could have simplified calculation. With each equivalency the rates vary: in line 2, 1 *bariga* 1 *ban* 5 *sila* transforms into 1:15 in SPVN, in line 10, 2 *bariga* transforms into 2 in SPVN. In line 13, 1 *bariga* 5 *ban* transforms into 1:50. However, with a uniform SPVN in-kind transformation, only the multiplication table for 10 was needed to carry out multiplication once reciprocals were found for each in-kind rate. Thus, three numerical tables were required to make these four equivalencies: the standard reciprocal table, an approximate reciprocal table and the multiplication table of 10. The equivalency in lines 7 and 8 was a one-to-one rate in SPVN so that the author did not even need a numerical table to make this equivalency. Thus, SPVN vastly simplified calculation with YBC 07473, while metrological tables probably defined acceptable measurement values in this text. Metrological and numerical tables were methods to produce conformity within YBC 07473.

8.3 Estimation, Observation and Labor

Labor could, and was, also estimated by means of rates. Englund (2012: 436) points to over 2000 statements of labor in the Ur III period showing that this type of calculation was not new in the Old Babylonian period. The rates discussed in

Chap. 5 were only a part of labor calculation. These texts estimated expenses associated with labor by means of 'wage rates' and make up the bulk of evidence for labor discussed in this volume: Ashm 1923-315, Ashm 1922-281, Riftin 1937: no. 114, Riftin 1937: no. 116, MAH 15886 + 16295,[15] LB 1074, LB 1078, LB 1069 and AO 08461. These type of texts can be called either grain-rate texts if a rate in grain to define a grain allocation is present, or grain-wage texts if only total wages in grain are stated. However, wages were computed out of a quantity of men or man-days of labor, which was computed out of an amount of work to be done in a project by means of a work assignment or labor rate. Labor makes up the subject of this section, from the computation of a project in NBC 11509 and NBC 06763, to labor out of a project computation by means of a labor rate in YBC 12273, to man-days of labor which are stated in Riftin 1937: no. 114, Riftin 1937: no. 116, MAH 15886 + 16295 as well as Riftin 1937: no. 115. The question here is: how was labor calculated? Were there discrepancies associated with these calculations? If so, how did the ancient scribes and bureaucrats cope with these discrepancies?

8.3.1 Volume, Labor and Wages in Economic Texts

Both NBC 11509 and NBC 06763 seem to describe a project—the excavation of canal stretches—and possibly served as a project statement or assessment, that is, a statement describing a project to be carried out. In each, a length, width, depth and then volume is stated for each canal length. Both texts make up part of the same bureau, the bureau of irrigation and excavation, even though they were authored by different scribes, were separated by about 7 or 8 years and, in all likelihood, were produced in different locations.[16] NBC 11509 states estimations of silt volume to be excavated by *Rīm-Sîn-rappašunu*. This name appears in Riftin 1937: no. 114, Riftin 1937: no. 115, Riftin 1937: no. 116 and MAH 15886 + 16295 as well, where he is charged with quantities of men and grain. He is thus charged with labor and wages, which were probably exploited in pursuit of an excavation similar to those found in NBC 11509. NBC 11509 is divided into five columns, a column for a length, width, depth, volume and a label for each canal section. The excavations implied by Riftin 1937: nos. 114 and 116 and possibly by MAH 15886 + 16295—the grain-rate texts associated with this bureau—are similar but not the same as that described in NBC 11509 because *Rīm-Sîn-rappašunu* is charged with six canal sections in NBC 11509, while in Riftin 1937: no. 114 he is responsible for four overseers, in Riftin 1937: no. 116 he is in charge of five overseers, and in MAH 15886 + 16295 he is charged with six chief workers.

NBC 11509 clearly estimates silt volume to be excavated from the canal and does not represent actual silt that was already excavated. This is clear by the volume statements, which reflect exactly calculations of volume based on the prior three

[15]For this text's tentative connection to the bureau of irrigation and excavation, see Sect. 4.2.

[16]Discussion of NBC 11509 and NBC 06763 follows their discussion in Middeke-Conlin (2018).

columns: length by width by depth produced volume. The date only states the day and month, not the year, implying it was only valid within the year it was written and not afterward. Finally, the low quality of clay used to produce the tablet suggests that the text written on the document was not permanent. All this suggests that the text was temporary and that the calculations used to produce NBC 11509 were predictive. Data did not reflect a current reality even if the values used to produce the estimated volume were based on an observation. That is to say, volume had not been excavated yet, so that the actual volume excavated was not deduced. NBC 11509 only states the volume that is expected to be excavated. NBC 11509 is predictive then, and would become redundant after the compilation of a new text stating the completed excavations.

NBC 06763, an unprovenanced tabular text attributed to *Immer-ilī* of the bureau of irrigation and excavation, describes the excavations of a series of canal sections as well. NBC 06763 is divided into five columns just like NBC 11509: length appears in column 1, width in column 2, depth in column 3, volume in column 4 and a label for each canal section in column 5. It shows a total excavation as well as a statement of who is in charge of these excavations. However, unlike NBC 11509, the volume measurement values on NBC 06763 are not related to a simple calculation of length by width by depth. With all but place 2 in line 4, length multiplied by width and by depth does not produce the volume measurement values in column 4. Table 8.10 sums up these discrepancies.[17]

In addition, when these volume measurement values are added together, they do not produce the subtotal volume in lines 12 through 13. Unless they are the products of a series of mistakes, volume measurement values were made from observations other than length, width and depth. How were the volume measurement values written on NBC 06763 produced? What measurement values do the subtotal and total reflect?

8.3.2 Volume, Labor and Wages in the Mathematical Tradition

To answer this, it may help to explore further how labor was calculated in the mathematical tradition and whether this tradition expresses reality. Are there any mathematical texts that described labor calculations? If so, how well do these texts reflect the economic texts? Calculation of volume is present in Old Babylonian mathematical texts like YBC 04663. This procedure text is probably from southern Babylon, although its exact provenance is uncertain. YBC 04663 presents eight problems and their solutions.[18] Problem 1 will serve as an example.

[17]Following Middeke-Conlin (2018: 285, Fig. 2).

[18]For more on YBC 04663, see especially Neugebauer and Sachs (1945: 69–71 edition, pl. 7–32 copy); Høyrup (2002: 305, 345–347 discussion); and Proust (forthcoming: problems 1–2, discussion).

Table 8.10 Differences between stated and expected volume in NBC 06763

I. Line	II. Stated volume	III. Expected volume	IV. Difference	V. Per cent difference (%)	VI. Excess or deficit
2	1 *iku* 38 5/6 *sar*	1 *iku* 39 1/2 *sar* 9 1/2 *gin* 15 *še*	2/3 *sar* 9 1/2 *gin* 15 še	0.592	Deficit
3	25 *sar*	25 *sar*	–	–	No difference
4	1 *iku* 1 *ubu* 26 1/2 *sar* 6 2/3 *gin*	1 *iku* 1 *ubu* 25 *sar* 11 2/3 *gin*	1 1/3 *sar* 5 *gin*	0.808	Excess
5	1 *ubu* 9 1/2 *sar*	1 *ubu* 9 5/6 *sar* 7 *gin* one-6th 10 še	1/3 *sar* 7 *gin* one-6th 10 *še*	0.757	Deficit
6	13 *sar* 6 2/3 *gin*	12 5/6 *sar* 7 2/3 *gin* 20 *še*	8 5/6 *gin* 10 *še*	1.143	Excess
14	15 *sar* 10 *gin*	15 1/3 *sar* 5 *gin*	1/3 *sar* 5 *gin*	2.674	Deficit

A trench: 5 *ninda* (is) the length, 1 1/2 *ninda* <the width>, (and) 1/2 *ninda* the depth. 10 <*gin*> volume (is) the work assignment, 6 *š*[*e* (is) its (silver) wages.] What are the area, the volume, the workers, and the silver (total)? You to know it:
Make the length encounter the width, it will give you 7:30.
Raise 7:30 to the height, it will give you 45.
Detach the reciprocal of the work assignment, it will give you 6. Raise to 45, it will give you 4:30.
Raise 4:30 to the wages, it will give you 9. The procedure.

In this problem, calculating volume is just the first step in estimating costs in labor, both man-days and wages. In the setup for problem 1, measurement values are stated, while the procedure only uses SPVN. Because there is explicit use of SPVN in calculation, all measurement values were probably transformed into SPVN by the author of YBC 04663 prior to calculation, even if this transformation was not explicitly described. This is seen in other texts, like VAT 08521 problem 1 concerning interest calculation, and perhaps with equivalencies in YBC 04698 statement 3, and begs the question: did the scribe take transformations to and from SPVN and calculation with SPVN as a given?

YBC 04666, a catalogue text that presents 23 problem statements, explores the costs incurred in excavating variously shaped small canals. Problem 1 of this text shows a grain rate of 1 *ban* which appears through the next three problems in this text (see Appendix 1.B). Thus, between YBC 04663 and YBC 04666, both silver and grain were used to assess cost associated with an excavation. However, unlike YBC 04663, problem 1, no procedure is present, so that measurement values were not transformed to and from SPVN. Also, unlike YBC 04663 problem 1, the answer in YBC 04666 problem 1 is stated in measurement values. In addition, as both

Table 8.11 UET 6/2 233 interpretation

Interpretation		
5	10	5 × 2 = 10
2	30	10 × 3 = 30
3	3	10 ~ 6
10 ~ 6		30 × 6 = 3
2	6	3 × 2 = 6

Robson (1999: 252–255, esp. 253) and then Friberg (2000: 123–127, esp. 125) point out, texts like YBC 04663 problem 1 can be connected to numerical exercises like UET 6/2 233 from the city of Ur (Table 8.11).

The Ur texts all carry out calculation using a step-by-step process and incorporate what seems to be the same coefficients as are attested in YBC 04663 problem 1. 10 in UET 6/2 233 can be understood as the SPVN transformation of the work assignment of 10 *gin* as witnessed in YBC 04663 problem 1, while 2 can be understood as the SPVN transformation of 6 *še* wages seen in the same problem. If this connection is accepted, then it shows that problems similar to problem 1 of YBC 04663 were practiced at Ur as part of a scribal mathematical curriculum.

On the one hand, there are texts which state a problem using measurement values but no procedure, while on the other hand, there are texts which show a procedure using SPVN numbers, but without stating a problem. These two texts are combined with texts like YBC 04663 problem 1 so that the problem, stated using measurement values, and the procedure stated using SPVN numbers, appear in one place. All of this suggests that transformation to and from SPVN was assumed in these mathematical texts.

The solution in YBC 04663 problem 1 is found through a step-by-step process similar to that expressed in a purely numerical manner in UET 6/2 233; length is multiplied by width to produce area, area by depth to produce volume, the reciprocal of the work assignment, or the amount of work one man can carry out in one day, is found and multiplied by volume to produce the number of workers, and finally the number of workers is multiplied by wages to produce cost in silver for the excavation. All numbers would have then been transformed into measurement values (Table 8.12).

Table 8.12 Calculation in YBC 04663, problem 1

Length: 5 ninda → 5 (table of length) Width: 1 1/2 ninda → 1:30 (table of length Depth: 1/2 ninda → 6 (table of height/depth) Work assignment: 10 gin_2 → 10 (table of weight) Wage rate: 6 še → 2 (table of capacity)
5 × 1:30 = 7:30 7:30 × 6 = 45 The reciprocal of 10 is 6 45 × 6 = 4:30 4:30 × 2 = 9

Multiplication by length, width and depth in NBC 11509 is similar to that carried out in YBC 04663, although a base is not stated in NBC 11509. This is expected. The author of NBC 11509 was administering an excavation, not writing a mathematical exercise. While all data necessary to carry out calculation is provided in columns 1 through 3, only volume is necessary in NBC 11509 so that each calculation step need not be stated. Vocabulary is also slightly different: while YBC 04663 states length as 'us$_2$', it is listed as 'gid$_2$' in NBC 11509. This suggests that NBC 11509 represents a mathematical tradition similar to that witnessed in YBC 04663 but with some microcultural variation in relation to vocabulary.

In YBC 04663, the estimated volume is used to assess cost in labor and wages. This is reflected in the grain-rate texts connected to NBC 11509 discussed below. These texts assessed costs in grain of an unstated project by multiplying amounts of men by wage rates.[19] Together, this group of texts present two parts seen in YBC 04663's cost estimate: a project statement that estimated volume to be excavated with NBC 11509 and then costs estimates in labor and grain with the grain-rate texts associated with NBC 11509.[20] However, the quantity of men stated in the grain-rate texts was not clearly calculated out of a volume, as it was in YBC 04663. Is there an economic text from which labor was calculated out of volume?

8.3.3 Sexagesimal Place Value Notation, Volume and Labor

YBC 12273, from the same bureau but dated to the period after *Hammu-rābi* of Babylon conquered the kingdom of Larsa, describes both volume to be excavated and labor expended in a canal maintenance project. In the first three columns of this text, corresponding to length, depth and width, numbers appear without measurement units, rendering them ambiguous to the modern observer. After this, starting with volume in column 4, measurement values appear so that magnitude is expressed. Column 1 shows that these ambiguous numbers take on base sixty because the entries in column 1, lines 2, 3, 5 and 6 add up to the number in line 8 (Table 8.13).[21]

These numbers could plausibly represent either SPVN or *ninda* measurement values, which, as seen in Chap. 2, are numbered 1 to 59.[22] Assuming the numbers

[19]Clevenstine (2015) suggests that these texts present 'prospective estimates of the resources to be deployed in the projects named at the bottom of the table'.

[20]See Appendix 1.A for Riftin 1937: no. 116 and its interpretation and Appendix 2.W for the author of these texts.

[21]Note that canal lengths were added together in other excavation texts, such as in Ashm 1922-290. Thus, it is not surprising that these values would have been added together. It is, however, surprising that the total would appear in SPVN, reflecting addition in SPVN, and not as an expected measurement value.

[22]45 (ninda) in row 2, 10 (ninda) in row 3, 1 (uš) 30 (ninda) in row 5, 2 (uš) in row 6 and 4 (uš) 25 (ninda) in row 8.

Table 8.13 Addition in YBC 12273

Line	Note	Number
2		45
3		10
5		1:30
6		2
8	Total	4:25

in columns 1 through 3 were used in their written form, without transformation, to produce volume, the calculation of volume works as seen in Table 8.13.

While in line 5 calculation works as expected and shows that the numbers in this line take on a sexagesimal structure, in lines 2 and 3 the stated numbers in columns 1 through 3 do not produce the volume in column 4. Length by depth by width produces half the stated volume in column 4 (Table 8.14). However, another value for width is present in the extant portion of line 9, 1/2 *ninda* 2 *kuš*, which transforms to 40 in SPVN. When 40 is used instead of the stated 20, the expected volume is produced (Table 8.15). 40, not 20, was used to produce the volume in column 4 lines 2 and 3. Why is this?

Depth is stated as 30 in a place value notation in column 2, lines 2 and 3, as well as 1 in a place value notation in lines 5 and 6. If length in line 2 is transformed from 45 *ninda* (270 m) and if total width is 1/2 *ninda* 2 *kuš* (4 m), then 30 depth would have to correspond to 1/2 *kuš* (25 cm) depth. In column 2 line 5, place value 1 would have to correspond to 1 *kuš* (50 cm) if the number in column 1 represents 1 *uš* 30 *ninda* (540 m) and the width is 3 *kuš* (1.5 m). This would mean numbers are in SPVN, not partial-SPVN, because 1/2 *kuš* both transforms into SPVN 30 and corresponds to 15 *šusi*.

The coefficients in lines 2 and 3 may help to explain the excavation. In line 2, the coefficient is 10 *gin*, while in line 3 it is 1/3 *sar*. These coefficients are found in YBC 07164, problems 2 through 7. YBC 07164 concerns the digging of small subsidiary canals. Problem 7 defines an excavation as 5 *ninda* length by 3 *kuš* width by 3 *kuš* depth. Work is divided by depth: the work assignment for one man digging to a depth of 1 *kuš* is 1/3 *mana*, while at a depth of 1 *kuš* and below, the work assignment is 10 *gin*. Both 1/3 *mana* and 1/3 *sar* transform to 20 in SPVN and both correspond to 20 *gin*.

Table 8.14 Expected calculation of columns 1–3 in YBC 12273

Line 2: 45 × 20 × 30 = 7:30 7:30 → 7 1/2 *sar* volume (table of area/volume)
Line 3: 10 × 20 × 30 = 1:40 1:40 → 1 2/3 *sar* volume (table of area/volume)
Line 5: 1:30 × 1 × 15 = *22:30* *22:30* → 22 1/2 *sar* volume (table of area/volume)

Table 8.15 Calculation of columns 1–3 in YBC 12273

Line 2: $45 \times \underline{40} \times 30 =$ *15* *15* → 15 *sar* (table of area/volume)
Line 3: $10 \times \underline{40} \times 30 =$ *3:20* *3:20* → 3 1/3 *sar* (table of area/volume)

While depths in YBC 12273, if interpreted correctly, are probably different from those stated in YBC 07164 problem 7, it is possible to suggest the shape of the canal described in YBC 12273 based on the dimensions, coefficients and textual organization. Lines 2 and 3 are listed together, as are lines 5 and 6, so that only one to two actual canal stretches are excavated. In line 2, the depth is perhaps the lower of the two sections along a single stretch of the excavation because the workload is 10 *gin*, the workload below 1 *kuš* in YBC 07164 problem 7. The upper section of this stretch is, then, in line 3, where the workload is 1/3 *sar*, which corresponds to the workload above 1 *kuš*, that is, 1/3 *mana* in YBC 07164 problem 7. Interestingly, length of the upper canal in YBC 12273 is only proposed to be 10 *ninda* while the lower canal is proposed to be 45 *ninda*. Dredging or widening could explain this, as well as the reasons why *dagal* is repeated in line 1 of column 3, the additional statement of width in line 9, as well as why 20, rather than 40, appears as width in lines 2 and 3. First, problems 8 through 12 of YBC 07164 describe a canal of 5 *ninda* length, 1 *kuš* width, and 1 *kuš* depth that is to be widened by 1/2 *kuš* on each side. The author of YBC 12273 could be describing an excavation similar to the widening exercises presented in YBC 07164 problems 8 through 12. The canal is either being widened or dredged so that 20, the SPVN transformation of 4 *kuš*, is removed from each side of the canal, while the total width dredged is 40, the SPVN transformation of 1/2 *ninda* 2 *kuš* stated in line 9. Thus, the lower canal needed to be dredged of silt or widened to a length of 45 *ninda*, while the upper level only needed dredging or widening along a stretch of 10 *ninda*. This would prove the utility of problem texts like YBC 07164 (Fig. 8.1).

Volume is calculated as expected in line 5 and presumably line 6. Length is 1:30, perhaps 1 UŠ 30 *ninda*, depth is stated as 1, perhaps 1 *kuš*, and width is 15, perhaps 3 *kuš* if magnitude is similar in lines 2 and 3. With line 6, length is 2, perhaps 2 UŠ, while the remaining two dimensions are the same as line 5. Perhaps this is an extension of the same dredging project, so that each length is one side of the canal. Thus, line 5 would be one bank and line 6 would be another, while the reason for this division would be that the bank of line 5 did not need to be dredged along the

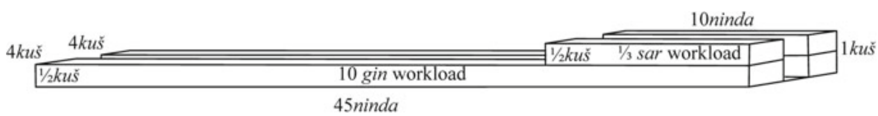

Fig. 8.1 Canal dredging project, YBC 12273, lines 2–3 (not to scale)

full length of line 6. It is difficult to state why the depth of this extension would be 1 *kuš* rather than 1/2 *kuš*. However, YBC 07164, problem 6, provides a workload of 7 1/2 *gin* for depths below 3 *kuš* so that perhaps these two lengths are at a lower depth. Thus, these two lengths would be the lowest level of the canal and then the total canal depth would be 2 *kuš* (1 full meter).

Width is only stated as 15, possibly corresponding to 3 *kuš*, which would be less than the 4 *kuš* per side of lines 2 and 3. Perhaps this reflects the slope of canals. Discussing mathematical texts, Powell (1988: 163) states: 'Two types of irrigation ditches are attested: one with vertical profiles to the sides, one with sloping profiles'. Explaining this phenomenon, Pemberton et al. (1988: 210) points out that 'the shape of the various categories of canal is determined by the maximum water flow in each channel. Channels flowing in alluvium and transporting a similar material will tend to form a classic, semi-elliptical shape'. Canals are wider at the top than the bottom so that it would be expected that less would be excavated towards the canal's base. Unfortunately, the workload for lines 5 and 6 is broken so that it cannot be confirmed whether this length is at a greater depth than the other two sections. However, if each line describes one canal bank, then the entire canal described in lines 5 and 6 would look similar to Fig. 8.2.

The rest of the calculation in YBC 12273 works as expected. Volume in column 4 is multiplied by the workloads in column 5 to produce man-days of labor in column 6 (Table 8.16).

All of this shows that numbers in columns 1 through 3 are probably not an abbreviated form of length measurement values, a partial-SPVN as described in Chap. 5, but are probably a form of SPVN. This is why the dimensions used in columns 1 through 3 to produce volume in column 4 are ambiguous to the modern observer.

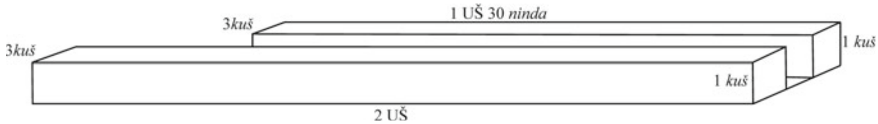

Fig. 8.2 Canal dredging project, YBC 12273, lines 5 and 6 (not to scale)

Table 8.16 Calculation of labor in YBC 12273

Line 2: 10 *gin* → *10* The reciprocal of *10* is <u>6</u> *15* × <u>6</u> = *1:30*
Line 3: 1/3 *sar* → *20* The reciprocal of *20* is <u>3</u> *3:20* × <u>3</u> = *10*

A few caveats must be raised here. As shown above, column 1 is added together. As Proust has pointed out, SPVN was not typically added together (private communications). However, the goal of the text was probably man-days of labor out of volume. This can be surmised because SPVN appears only with columns 1 through 3, while measurement values appear with columns 4 through 6. Columns 4 through 6 reflect numeric data that would be used to report to a higher authority or as reference for a later text. Thus, SPVN numbers may be simple glosses used to clarify how volume measurement values were obtained. As speculated in Chap. 5, this would mean that SPVN numbers were recognizable to the scribes working in this bureau who would refer to this text, even if they are ambiguous to modern observers.

In addition, numbers are non-normalized, as is clear from the written '4' in column 1 line 8, whereas SPVN is typically normalized (see Sect. 2.1.3 for this distinction). However, non-normalized script was typically used in legal and administrative texts, so that non-normalized numbers may simply be a symptom of the administrative environment this text invokes. The appearance of non-normalized numbers would express how the ancient scribe translated SPVN numbers from mathematical thought into an economic text.

YBC 12273 shows that the labor rates presented in Old Babylonian texts reflect, to an extent, administrative practice. A rate of 10 *gin* volume excavated per man-day of labor for lower levels, and 1/3 *sar* volume excavated per man-day of labor for an upper level, as shown in YBC 07164 problem 7, reflected practice in YBC 12273 to a degree. Only the depths associated with these coefficients varied between texts. Thus, both SPVN appear in a calculated volume to produce a project statement, while labor in man-days is produced from this project statement and work assignments, reflecting to a limited degree calculation in the mathematical texts concerning excavations. To confirm this hypothesis, it would help to find additional texts from a professional environment dealing with canal excavations that also make use of SPVN in calculating volume. This would show that SPVN was used in calculation, and that the interpretation of value transformation from SPVN is correct, and through this that the rates of 10 *gin* volume and 1/3 *sar* volume excavated per man-day of labor do correspond to depths as seen in YBC 12273.

8.3.4 Sexagesimal Place Value Notation, Volume and Scribal Practice

BM 085211 and BM 085238[23] also present canal excavation projects but are both dated to *Samsu-Iluna*'s seventh year in power—after YBC 12273 was produced. In

[23]For the transliteration and translation of BM 085211, see Robson 2014: BM 085211 (unpublished) [Tabular account] http://oracc.museum.upenn.edu/obta/P412466/html. Accessed 30 June 2018. For the transliteration and translation of BM 085238, see Robson 2014: BM 085238 (unpublished) [Tabular account] http://oracc.museum.upenn.edu/obta/P412467/html. Accessed 30 June 2018.

fact, they both assume the same format and, from what is extant, seem to present the same canal excavation project. The focus here is on BM 085238 because it is much more complete. This text is divided into six columns: column 1 states a length (uš), 2 an upper width (sag an-na), 3 is simply labeled width (sag) and 4 states a depth (gam), while 5 states a volume (saḫar) and 6 a total volume—written saḫar-ḫi-a, 'various volumes'—as well as descriptors, usually names of persons. Calculation seems to follow that exhibited in YBC 04663 problem 1, but numbers in columns 1–5 are ambiguous. However, unlike YBC 12273, magnitude might be provided. The subtotal in line 9 of this text, 7:25 *ninda uš*, suggests that the sexagesimal numbers transform to *ninda* measurement values. Thus, 40 in line 2 must transform to 40 *ninda*, '3:35' in line 4 must transform to 3 *uš* 35 *ninda*, and 2:30 in line 6 must transform to 2 *uš* 30 *ninda* in order for this total to be correct.

These are not a kind of partial-SPVN number. Line 7 proves this: 30 in column 1 must stand for 30 *ninda* in order for the total in line 9 to be correct. If written '1(diš) kuš$_3$' in column 4 denotes 1 *kuš*, then written '2(u)' width must transform to 4 *kuš* in order for the total volume in column 6, 10 *sar*, to be correct. Thus, SPVN is clearly used in column 2 and therefore in column 1, 3 and 4 as well.

Table 8.17 sums up extant calculation in BM 085238, confirming this synopsis. For each line, an upper row states either a transcription of numbers found on the tablet and used to produce volume or is the product of numbers found on the tablet and used to produce volume. The numbers in the lower row are expected transformations of these numbers to metrological values. Note that volume only appears as measurement values, not as an SPVN number. Thus, 15 in column 2 of line 2 transforms to 3 *kuš*, while 30 in column 4 must transform to 1/2 *kuš* or 15 *šusi* in order for total volume in column 6 to be correct at 5 *sar*.

The surveyor's formula, a tool used to estimate the area of a trapezoidal or other irregular figure, is used in columns 2 and 3 to estimate length. This is clear in line 8, where in order for the total volume to be correct, length 20 in column 2 and length 15 in column 3 must be appended together and then divided in half, producing 17:30, which transforms into 3 1/2 *kuš*. This formula is exhibited in lines 6, 8, 10, rev. 8' and rev. 12'.

The author of this text had trouble transforming numbers. The totals in lines 4 and 6 of the obverse and lines 4', 6', 9', 11' and 12' of the reverse betray mistakes, often in transformation. This suggests BM 085238 is the work of a student, perhaps an apprentice, which is underlined by the repetition of this text with BM 085211—it is a standard exercise.[24] While the author could transform, for instance, SPVN 5

[24]If these two texts are not scribal practice exercises, they represent an incredible decline in competence within this bureau between the reign of *Hammu-rābi* and *Samsu-iluna*. Note that, because these texts are considered apprenticeship texts, and not actual economic texts, they are treated as mathematical texts in the text index and throughout this work. This is because, if they are part of an education, they may not represent the end result of this education but only a young professional's understanding of practice in the stage of professional development that the texts belong to. Thus, they are also not incorporated in Appendix 5, nor in the study of numeracy by scribe in Appendix 2.

Table 8.17 Calculation in BM 085238

Obv.	Length (column 1)	Width (columns 2 and 3)	Depth (column 4)	Volume (SPVN)	Expected transformation	Stated volume (column 6)
2	40 ×	15 ×	30 =	*5*	→ 5 *sar*	5 *sar*
	→ 40 ninda	*→ 3 kuš*	*→ 1/2 kuš*			
4	3:35 ×	20 ×	1 kuš$_3$ =	*1:11:40*	→ **1** × **60** + 11 2/3 *sar*	1 *iku* 11 2/3 *sar*
	→ 3 uš 35 ninda	*→ 4 kuš*	*→ 1 kus*			
6	2:30 ×	*17:30** ×	1:30 kuš$_3$	*1:5:37:30*	→ **1** × **60** + 5 **1/2 *sar* 7 2/3 *gin***	1 *iku* 5 2/3 *sar*
	→ 2 uš 30 ninda	*→ 3 1/2 kuš*	*→ 1 1/2 kuš*			
7	30 ×	20 ×	1 kuš$_3$ =	*10*	→ 10 *sar*	10 *sar*
	→ 30 *ninda*	→ 4 *kuš*	→ 1 *kuš*			
8	10 ×	*17:30** ×	2 kuš$_3$ =	*5:50*	→ 5 5/6 *sar*	5 5/6 *sar*
	→ 10 ninda	*→ 3 1/2 kuš*	*2 kuš*			
10	3:15 ×	*17:30** ×	2 kuš$_3$ =	*1:53:45*	→ 1 *iku* 13 2/3 *sar* 5 *gin*	1 *iku* 13 2/3 *sar* 5 *gin*
	→ 3 uš 15 ninda	*→ 3 1/2 kuš*	*2 kuš*			
Rev						
4’	1:15 ×	15 ×	1 kuš$_3$ =	*18:45*	→ **18** 2/3 *sar* 5 *gin*	19 2/3 *sar* 5 *gin*
	→ 1 uš 15 ninda	*→ 3 kuš*	*→ 1 kus*			
6’	2:22:20 ×	15 ×	1 kuš$_3$ =	*35:35*	→ 35 1/2 *sar* **5 *gin***	1 × 60 + 35 1/2 *sar* 7 1/2 *gin*
	→ 2 uš 22 1/3 ninda	*→ 3 kuš*	*→ 1 kus*			
8’	1:20 ×	*12:30*** ×	1:30	*25*	→ 25 *sar*	25 *sar*
	→ 1 uš 20 ninda	*→ 2 1/2 kuš*	*→ 1 1/2 kuš*			
9’	4:35 ×	15 ×	1 kuš$_3$ =	*1:8:45*	→ **1** × **60** + 8 2/3 *sar* 5 *gin*	1 *iku* 8 2/3 *sar* 5 *gin*
	→ 4 uš 35 ninda	*→ 3 kuš*	*→ 1 kus*			
11’	5 ×	15 ×	1 kuš$_3$ =	*1:15*	→ **1** × **60** + 15 *sar*	1 *iku* 15 *sar*
	→ 5 uš	*→ 3 kuš*	*→ 1 kus*			

(continued)

Table 8.17 (continued)

Obv.	Length (column 1)	Width (columns 2 and 3)	Depth (column 4)	Volume (SPVN)	Expected transformation	Stated volume (column 6)
12’	40 ×	*17:30** ×	2 $kuš_3$ =	*23:20*	→ 23 **1/3** *sar*	1 × 60 + 23 2/3 *sar*
	→ 40 ninda	*→ 3 1/2 kuš*	*2 kuš*			
	*Surveyor’s formula A			**Surveyor’s formula B		
	20 + 15	*= 17:30*		15 + 10	*= 12:30*	
	2			*2*		

into 5 *sar* in line 2, or 10 into 10 *sar* in line 7, he mistakenly transformed 1:11:40 into 1 *iku* 11 2/3 *sar* rather than the expected 1 × 60 + 11 2/3 *sar* in line 4. He did transform ‘1:53:45’ correctly to 1 *iku* 13 2/3 *sar* 5 *gin* in line 10. Line 10 is an exception, however, because the author generally had trouble transforming SPVN numbers into *iku* measurement values even if he was able to transform *sar* measurement values correctly. These mistakes in transformation underline that numbers in columns 1 through 5 of these two texts are in SPVN, not a partial place value. Perhaps transformation was difficult for the student when measurement values deviated from a sexagesimal structure, just as it was difficult when values themselves deviated from the metrological tables, as seen in Sect. 7.3. Interestingly, the author rounded up the total volume in line 6, from 5 1/2 *sar* 7 2/3 *gin* to 5 2/3 *sar*, showing that rounding numbers was taught in this bureau. Thus, the appearance of SPVN in YBC 12273 is somewhat confirmed by these two texts. YBC 12273 probably reflects practices as learned in a professional environment, as is witnessed by BM 085211 and BM 085238.

8.3.5 Volume as an Observation of Labor

The measurement values on YBC 12273 could help explain the values found on NBC 06763. Volume on NBC 06763 could reflect observations produced out of man-days expended in excavation and compiled after completion of canal maintenance rather than estimations prior to, or the results of, an actual measured survey of silt to be excavated, as was seen in NBC 11509. An excavation probably did happen because there is a year date in this text, which would suggest it was an official record after a project’s completion, rather than part of a cost estimation or student exercise. In addition, although YBC 12273 is dated, the volume in YBC 12273 is a stylized estimation that could not reflect reality, so that YBC 12273 was also used to plan a project. Actual volume excavated would not match stated volume because silt does not settle in the shape of perfect rectangular prisms. Thus, the estimation is only a projection of the potential volume to be excavated, not the

actual volume that was excavated. This would mean that, in order to evaluate a completed project, an alternative to calculating volume based on length, width and depth must have been available to the Old Babylonian scribe, one based on observed values other than length by width by depth, and we need to turn to the mathematical texts again to find how this may have been done.

A method for calculating volume out of wages and labor rates is seen when YBC 04663 is examined again, this time, problem 7 (bold denotes pertinent text):

9 *gin* silver trench, the silver trench.
Rev
The silver of the trench. The length and the width I add and 6:30. 1/2 *ninda* [(is)its depth].
10 *gin* (is) the work assignment, 6 *še* (is) its wages. What are its length and width?
You to know it: **Detach the reciprocal of its wages**
(and) raise to 9 *gin* silver, it will give to you 4:30.
Raise 4:30 to the work assignment, it will give you 45.
Detach the reciprocal of its depth (and) raise to 45, it will give you 7:30.
Break 1/2 of the length and the width which are added, it will give you 3:15.
Make 3:15 encounter (itself), it will give you 10:33:45.
Tear out 7:30 from the middle of 10:33:45,
it will give you 3:3:45. Take its square root,
it will give you 1:45. To the 1 add, to 1 subtract,
it will give you the length (and) width: 5 <*ninda*> length, 1 1/2 *ninda* width.

While it is not the goal of problem 7, calculation of an excavation's volume is found out of the total cost of the excavation, 9 *gin* silver, as well as a wage rate of 6 *še* silver and work assignment of 10 *gin* volume per man. This is in pursuit of the original dimensions of the canal. Calculation appears as on Table 8.18.

One 'detaches' the reciprocal of the wage rate and 'raises' it to the total wages to find the total number of workers and then raises this to the work assignment to find the volume. This procedure suggests that the Old Babylonian scribe could calculate volume out of wages and man-days of labor using the same rates as he used to estimate total cost out of volume in the first place.

This is not an isolated practice. Volume is directly computed out of a quantity of men and a labor rate in Riftin 1937: no. 117[25] and BM 016391,[26] both of which are tabular texts dated to *Rīm-Sîn* year thirty-one and thirty-two respectively. In Riftin 1937: no. 117, a standard work assignment is 1/3 *gin* per man-day of labor, while in BM 016391 a standard work assignment is 1 1/2 *gin* per man-day of labor. Thus, in Riftin 1937: no. 117 line 5, 2 men out of 3 available men excavated 2/3 *gin* volume

[25]For the transliteration and translation of this text, see Robson (2014: SVJAD 117 [Tabular account]), http://oracc.museum.upenn.edu/obta/P412628/html. Accessed 30 June 2018.

[26]For the transliteration and translation of this text, see Robson (2014: BM 016391 (unpublished) [Tabular account]), http://oracc.museum.upenn.edu/obta/P412463/html. Accessed 30 June 2018.

Table 8.18 Calculation for problem 7 of YBC 04663

Wage rate to labor: the reciprocal of 2 is 30 9 × 30 = 4:30
Geometric statement of labor: 10 × 4:30 = 45

at a work assignment of 1/3 *gin*. In line 17, the total number of men employed in excavation work was 45 out of the available 57 2/3 men who excavated 15 *gin* volume at the standard work assignment of 1/3 *gin* per man-day of labor. Because fewer men are exploited than are available to several projects in each text, and thus presumably allocated to each project, it can be suggested that both Riftin 1937: no. 117 and BM 016391 justified labor expenditures after excavations of some form, whether canal excavations or another kind of excavation.[27]

Thus, as witnessed by both mathematical texts and economic texts, a method was accessible to the Old Babylonian scribe by which the author of NBC 06763 could have calculated volume other than the expected length by width by height. Unfortunately, NBC 06763 does not mention a wage rate or work assignment used to calculate volume—that was not its goal. Its goal was simply to assess volumes excavated. Because depths attributed to workloads varied between YBC 12273 and YBC 01764, it is difficult to state with certainty what the labor rates that could have produced the volume measurement values on NBC 06763 were. It is only possible to suggest that labor rates were used to produce volume. A similar phenomenon is present in Ashm 1922-290, where total volumes do not match expected volumes and the same process may be suggested: excavated volume was estimated based on actual observed labor and wages.

NBC 06763 is especially interesting because of the subtotal and total, which do not seem to represent the measurement values of volume written in the text (i.e. lines 3 through 7 and 14). As asked above, how were these values produced? According to Middeke-Conlin (2018:285–289), while each individual volume entry in NBC 06763 may have been based on observed man-days after excavation was completed, the subtotal of volume and total of volume seem to refer to an earlier text which estimated volume based on the stated length, width and depth. Addition makes better sense when the length, width and depth measurement values found on NBC 06763 are multiplied together, truncated to one-6th *sar* (10 *gin*) measurement values, and then added together. However, if this is accepted there is still a discrepancy of 10 *sar*, as is seen in Table 8.19.[28]

The omission of 10 *sar* could easily be an epigraphic mistake—the author mistakenly wrote 1(u) rather than 2(u). This variety of mistake was already seen in Chap. 6 while discussing mistakes on YBC 04224 and YBC 07195. The proposed truncation in NBC 06763 mimics the potential counting device presented in

[27]Riftin 1937: no. 117: 2, 5, 8, 10–14; BM 016391: 2–4, 7–12.

[28]Following Middeke-Conlin (2018: 288, Fig. 4).

Table 8.19 Stated and proposed addition in NBC 06763

Addition of stated volume measurement values							
Line	Notes	Volume					
2	Place 1	1 *iku*		38	5/6 *sar*		
3	Place 2			25 *sar*			
4	Place 3	1 *iku*	1 *ubu*	26	1/2 *sar*	6	2/3 *gin*
5	Place 4		1 *ubu*	9	1/2 *sar*		
6	Place 5			13 *sar*		6	2/3 *gin*
7	Place 6			6 *sar*		10	
10	Place 7			8 *sar*			
12	Extant subtotal	4 *iku*		26 *sar*		10 *gin*	
	Expected subtotal	4 *iku*		**27** *sar*		**13**	**1/3 *gin***
14				15 *sar*		10 *gin*	
15	Extant total	4 *iku*		41	1/3 *sar*		

Addition of expected volume measurement values truncated to *gin*						
Line	Notes	Volume				
2	Place 1	1 *iku*		39	1/2 *sar*	
3	Place 2			25 *sar*		
4	Place 3	1 *iku*	1 *ubu*	15 *sar*		
5	Place 4		1 *ubu*	9	5/6 *sar*	
6	Place 5			12	5/6 *sar*	
7	Place 6			6 *sar*		
10	Place 7			8 *sar*		
12	Extant subtotal	4 *iku*		26 *sar*		10 *gin*
	Expected subtotal	4 *iku*		16 *sar*		10 *gin*
14				**15** *sar*		10 *gin*
15	Total	4 *iku*		41	1/3 *sar*	

Chap. 6. The author of this text simply truncated values that would have made up a lower level of calculation, while adding upper level calculations. Indeed, this would have limited counting to the 5 spaces suggested for this device in Chap. 6 and by Proust (2000: 300–301). Truncation would have been acceptable because the author was aware of measurement inconsistency and knew the original calculation could not reflect reality, which is underlined by the updated volume measurement values in NBC 06763.

This all points to a layering of calculations in the text. At least two and perhaps more documents went into NBC 06763's production: an initial cost estimate visible in the subtotal and then total, which reflect NBC 11509, as well as one or a series of texts which state actual observed values based on man-days, reversing labor calculation as seen in YBC 12273. Labor rates were probably used for more than just estimating man-days of labor during an excavation, they could also estimate a completed project out of total labor expended, as witnessed in the economic texts

Table 8.20 Differences between stated and expected volume in Ashm 1922-290

I. Line	II. Stated volume	III. Expected volume	IV. Difference	V. Per cent difference (%)	VI. Excess or deficit
2	22 1/2 *sar*	22 1/2 *sar*	–	0	No difference
3	49 5/6 *sar*	45 1/2 *sar*	4 1/3 *sar*	9.523	Excess
4	1 *iku* 1 *ubu* 7 2/3 *sar*	1 *iku* 43 5/6 *sar* 6 *gin* one-4th	13 2/3 *sar* 3 2/3 *gin* 15 *še*	9.524	Excess
5	1 *ubu* 30 *sar*	1 *ubu* 23 *sar* 3 2/3 *gin* 15 *še*	6 5/6 *sar* 6 *gin* one-4th	9.495%	Excess
7	1 *ubu* 45 5/6	1 *ubu* 37 1/2 *sar*	8 1/3 *sar*	9.523	Excess
8	33 1/2 *sar*	30 1/2 *sar* 7 1/2 *gin*	2 5/6 *sar* 2 1/2 *gin*	9.387	Excess
9	2 *iku* 1 *ubu* 34 2/3	2 *iku* 1 *ubu* 9 5/6 *sar* 2 1/2 *gin*	24 2/3 *sar* 7 1/2 *gin*	9.540	Excess
11	2 *eše* 5 *iku* 23 1/2	2 *eše* 3 *iku* 1 *ubu* 24 *sar* 7 1/2 *gin*	1 *iku* 49 1/3 *sar* 2 1/2 *gin*	9.489	excess
12	4 *iku* 1 *ubu* 42 1/3	4 *iku* 17 *sar* 1 5/6 *gin* 7 1/2 *še*	1 *ubu* 25 *sar* 18 *gin* 2 1/2 *še*	5.453	Excess
16	2 *eše* 1 *ubu* 15 *sar*	2 *eše* 1 *iku* 12 1/2 *sar*	2 1/2 *sar*	3.817	Excess

Riftin 1937: no. 117 and BM 016391, as well as in the mathematical text YBC 04663 problem 7. Such a calculation might help to explain the unexpected values in NBC 06763 and Ashm 1922-290 (Table 8.20).

8.3.6 Labor as a Statement of Wages

In YBC 04663 problem 1, the total cost of the excavation in grain was produced out of man-days of labor by means of a wage rate. As noted above, Riftin 1937: no. 114 and 116, and MAH 15886 + 16295, all of the bureau of irrigation and excavation and all dated to *Rīm-Sîn*'s thirty-first year in power, presented wage rates and were thus called grain-rate texts. These texts, all written in a tabular format similar to NBC 11509, suggest a calculation was carried out to estimate cost. Riftin 1937: no. 116 lines 1 and 2 will be taken as an example.

Columns 1 and 2 state quantities of overseers and workers who are defined by their wage rates. In column 1 men are defined by the wage rate of 6 2/3 *sila* per man per day, while in column 2 men are defined by the wage rate of 2 *sila* per man per day. Column 3 presents the total men, column 4 total grain for 1 day and column 5 total grain for 30 days. A mathematical process is suggested here, so that it must be asked, how were wage rates calculated in the mathematical tradition?

Wage rate calculations appear in numerous mathematical texts from the Old Babylonian period, of which YBC 04663 problem 1, YBC 04666 problem 1 and UET 6/2 233 presented above, are just a few examples. The final line of YBC 04663 problem 1 presents how wages were calculated out of labor (bold):

> A trench: 5 *ninda* (is) the length, 1 1/2 *ninda* <the width>, (and) 1/2 *ninda* the depth. 10 <*gin*> volume/(is) the work assignment, **6 š[*e* (is) its (silver) wages**.] What are the area, the volume, the workers, and the silver (total)? You to know it:
> Make the length encounter the width, it will give you 7:30.
> Raise 7:30 to the height, it will give you 45.
> Detach the reciprocal of the work assignment, it will give you 6. Raise to 45, it will give you 4:30.
> **Raise 4:30 to the wages, it will give you 9**. The procedure.

While estimating the costs that would be incurred if a ditch was excavated, this problem presents a wage rate of 6 *še* silver, which transformed to SPVN 2, as well as showing how this rate works. The total number of workers, or man-days labor, was multiplied by this wage rate to produce the total cost of the excavation. Thus, the author could assess how much this excavation would cost in silver out of labor. As stated above, in YBC 04663, all measurement values were transformed into SPVN prior to calculation so that calculation is carried out in SPVN. While in this problem no quantities are transformed from SPVN at the conclusion of the problem, this is not the case for the entire text. The remaining problems do transform some or all values from SPVN numbers to measurement values. This transformation is secondary to the problem itself, although it does further illustrate the connection between SPVN numbers and measurement values. The text carries out calculation with SPVN, while transformation is made only after calculation and is secondary to the calculation in this mathematical text. This transformation was an assumed part of calculation, which is supported by the probable appearance of SPVN on YBC 12273 to calculate volume.

Returning to the calculation suggested in Riftin 1937: no. 116, it was noted that columns 1 and 2 state quantities of overseers and workers defined by their wage rates. In column 1, men are paid at 6 2/3 *sila* per man per day, while column 2 states men are paid at 2 *sila* per man per day. Column 3 presents the total number of men, column 4 the total grain for 1 day, and column 5 the total grain for 30 days. The total of men is stated in the centesimal system as described in Sect. 2.1.3.

Several operations are summed up in each line. First, for column 1, the labor and wages for overseers is laid out with the wage rate in the heading and the quantity of men in each successive line. In column 2 as well, the labor and wages for workers is summed up by the wage rate in the heading and the quantity of men in each line. In column 3, the total labor is added together for each line. In column 4, the total wages for one day is summed up, which is the addition of the quantity of men in column 1 multiplied by the wage rate in column 1's heading, and the quantity of men in column 2, multiplied by the wage rate in this column's heading. Finally, in

column 5, the total amount of wages for 30 days is summed up, which is the product of column 4 multiplied by 30 (Table 8.21).

Calculation works perfectly in the text and there is no doubt that labor and wages are estimated correctly based on the wage rate provided for each man. Not all quantities used to produce this text are stated, however, because the author was only interested in the total cost in men and grain per day and month, not an itemized cost

Table 8.21 Wage calculation in Riftin 1937: no. 116

Column 1: Men, overseers of 6 2/3 *sila*
Cost in men:
5 → *5* (centesimal system)
Wage rate:
6 2/3 *sila* → *6:40* (table of capacity)
5 × *6:40* = 33:20
Cost in grain
33:20 → 3 *ban* 3 1/3 *sila* (table of capacity)
Column 2: men of 2 *sila*
Cost in men:
6 hundred 1 × 60 + 7 → *11:7* (centesimal system)
Wage rate:
2 *sila* → *2* (table of capacity)
11:7 × *2* = 22:14
Cost in grain
22:14 → 4 *gur* 2 *bariga* 1 *ban* 4 *sila* (table of capacity)
11:7 men multiplied by a wage rate of 2, corresponding to 2 *sila*, produced 22:14 or 4 *gur* 2 *bariga* 1 *ban* 4 *sila*.
Column 3: total men per day

Notes	Total labor		
Overseers, of 6 2/3 sila			5
Men, of 2 sila	6 hundred	1 × 60	7
Total men	6 hundred	1 × 60	12

5 men plus 6 hundred 1 × 60 + 7 men produced 6 hundred 1 × 60 + 12 total men
Column 4: Total grain per day

Notes	Total grain				
Men, overseers of 6 2/3 *sila*			3 *ban*	3	1/3 *sila*
Men, of 2 *sila*	4 *gur*	2 *bariga*	1 *ban*	4	*sila*
Total grain per day	4 *gur*	2 *bariga*	4 *ban*	7	1/3 *sila*

3 *ban* 3 1/3 *sila* plus 4 *gur* 2 *bariga* 1 *ban* 4 *sila* produces 4 *gur* 2 *bariga* 4 *ban* 7 1/3 *sila*
Column 5: Day total by 30 days
Cost in grain, 1 day:
4(aš) 2(bariga) 4(ban$_2$) 7 1/3 sila$_3$ → *22:47:20* (table of capacity)
Days:
30 → *30* (system S)
22:47:20 × *30* = *11:23:40*
Cost in grain, 30 days:
11:23:40 → 2 × 60 + 16 *gur* 3 *bariga* 4 *ban* (table of capacity)
22:47:20, corresponding to 4 *gur* 2 *bariga* 4 *ban* 7 1/3 *sila* grain, multiplied by 30 (days) produces 11:23:40 corresponding to 2 × 60 + 16 *gur* 3 *bariga* 4 *ban* total grain

by labor type. However, while he may not show how calculation was performed, the author did calculate grain per labor type and this was based on the rates provided per labor type, either 6 2/3 *sila* per man per day or 2 *sila* per man per day. Transparency is maintained by stating the wage rates used in this project.

Labor and wages are also stated in Ashm 1922-281, a grain-wage text that is proposed to have belonged to the same bureau but dated to *Rīm-Sîn*'s first year in power, 30 years before Riftin 1937: no. 114 and 116 were produced. Ashm 1922-281 suggests rates at 1 *ban* and 2 *ban* were used to evaluate wages, although the wage rates were not stated as they were in Riftin 1937: no. 116. Moreover, with eleven disbursements 1 *bariga* is added to the total wages. Similar to Riftin 1937: no. 116, the quantities of men are stated in the centesimal system described in Chap. 2. The substructure of this system becomes especially important with Ashm 1922-281. Quantities below 100 are stated in system S, which facilitates easy transformation to SPVN of smaller numbers. Here, lines 7 and 11 are used as examples of how calculation was probably carried out in this Ashm 1922-281. Lines 7 and 11 read as follows:

	1	2	3
7	1 × 60 + 5	2 *gur* 1 *bariga* 5 *ban*	*Enlil-nāṣir*
11	40	2 *gur* 3 *bariga* 2 *ban*	*Ḫabliya*

In Ashm 1922-281, column 1 corresponds to an amount of men, column 2 states grain associated with this quantity of men and column 3 states a person who is presumably charged with the labor and grain in columns 1 and 2.

Like with Riftin 1937: no. 116, several operations are summarized in each line (Table 8.22). First, there is a wage rate calculation. 1:5 multiplied by a rate of 10 produces 10:50, which transforms to 2 *gur* 5 *ban*. 40 multiplied by 20 wage rate produces 13:20, which transforms to 2 *gur* 3 *bariga* 2 *ban*. In line 7, 1 *bariga* is added to 2 *gur* 5 *ban* to produce the total grain disbursement of 2 *gur* 1 *bariga* 5 *ban*. Line 11 needs no addition, however. None of this is stated because the goal of this list was merely to state labor and wage allocations made to each individual listed by name in the text.

Table 8.22 Wage calculation in Ashm 1922-281

Line 7	**Line 11**
Men: 1 × 60 + 5 → *1:5* (centesimal system) Unstated rate: 1 *ban* → 10 (table of capacity) *1:5* × 10 = 10:50 Partial cost in grain: 10:50 → 2 *gur* 5 *ban* Total cost in grain: 2 *gur* 5 *ban* + 1 *bariga* = 2 *gur* 1 *bariga* 5 *ban*	Men: 40 → *40* (centesimal system) Unstated rate: 2 *ban* → 20 (table of capacity) *40* × 20 = *13:20* Total cost in grain: *13:20* → 2 *gur* 3 *bariga* 2 *ban*

While both Riftin 1937: no. 116 and Ashm 1922-281 are hypothesized to belong to the bureau of irrigation and excavation, wage rates also appear to calculate grain allocations outside of this bureau. This is seen in LB 1074 and LB 1078, two grain-rate and wage texts of the grain harvest archive. Because both texts are constructed similarly, only LB 1074 is examined here. As stated in Chap. 5, these texts assume calculation of wages in lines 1 through 6 in order to state the disbursement of grain in line 8. A two-part process is visible: multiplication by rates and then addition of grain. Addition is presented in Table 5.4. As suggested in Chap. 6, the mistake in LB 1074 was possibly a lapse while using a counting device. However, because only the subtotal of wages is present, not individual entries for wages at the beginning of each text, and because rates are recorded instead of the actual calculated values for these entries, calculation was probably assumed with these texts. The author was comfortable leaving the values unspecified because stating the rates and totals was enough to restore these computed values.

In Table 8.23, wage calculations are summed up for LB 1074. Only two wage rates are stated in the text itself: 2 *ban* per man in line 1 and 1 *ban* per man in line 2, while no grain disbursement itself is described. Line 7 states the amount of laborers while line 8 states the total grain as, “their grain 4 *gur* 1 *bariga* 5 *ban*”. It does not state grain was disbursed; instead it was allocated to these varieties of labor in advance of the harvest. This implies planning—a projection of costs in advance of work, which is confirmed by the remaining expenditures in lines 10 through 15. In these lines, wages are not qualified by a rate. However, the total of this section does qualify these expenditures with ‘ba-zi’, ‘disbursement’, which is distinctly lacking from line 8. This tells the reader that grain in lines 10 through 15 was disbursed when required. We see here a distinction between a labor projection in lines 1

Table 8.23 Summary of wage calculations in LB 1074

2(ban_2) → *20* (table of capacity)
1(ban_2) → *10* (table of capacity)

I. Line	II. Notes	III. Men	IV. Wage rate	V. Total	VI. Transformation
1–2	Binders	*43*	× *20*	= 14:20	→ 2 *gur* 4 *bariga* 2 *ban*
3–4	Grain gatherers	*32*	× *10*	= 5:20	→ 1 *gur* 2 *ban*
5	Threshers	*5*	× 10	= 50	→ 5 *ban*
6	Threshing floor preparers	*2*	× 10	= 20	→ 2 *ban*
10–11	Reed carriers	*5*	× 20	= *1:40*	→ 1 *bariga* 4 *ban*
12	*Redum*	*7*	× 2	= *14*	→ 1 *ban* 4 *sila*
13	Craft and labor comptroller	*5*	× 2	= *10*	→ 1 *ban*
14	House servants	*3*	× 3	= *6*	→ 6 *sila-*
15	Ox drivers	*25*	× 2	= *50*	→ 5 *ban-*

through 9, and thus grain allocation based on this projection, and then a statement of unplanned labor in lines 10 through 15.

Ashm 1923-315, an unprovenanced and undated text which lists various grain disbursements, including labor, can provide a simple example of grain wage calculation as present in an economic text outside of the bureau of irrigation and excavation as well. The fifth disbursement is listed as flour rations for five days, although the reason for this disbursement is unstated. No rate is visible, but it is easy to see that wage calculation is a simple multiplication: five days multiplied by an unstated rate of 1 *bariga* 3 *ban* produces 1 *gur* 2 *bariga* 3 *ban* (Table 8.24). Calculation only required the multiplication table of 5.

AO 08461, produced by an official overseeing a local temple, palace or larger private estate, shows further just how prevalent calculation and disbursement of wages were. This text lists grain disbursements for multiple reasons, including rations for individuals, rations for troops, rations allocated to water transport and field preparation, as well as rations in bran for ten days, the reason for which is unstated. Interestingly, the rate used to define these rations shows a discrepancy. This rate was probably a rounded value, showing that the rate was only important as a guideline to estimate value in AO 08461. Only the total grain and days were important to this text. A simplified, rounded rate statement was all that was necessary for the purposes of the text (Table 8.25).

Wage calculation did exist outside of excavation and construction, in multiple environments including water transport and grain production and harvesting. It was carried out by bureau officials as well as household planners. Thus, wage and labor calculations cannot be limited to one environment but permeate economic activity

Table 8.24 Wage rate calculation in Ashm 1923-315

5	1(aš) 2(bariga) 3(ban$_2$) eš$_2$ šuku *ša* u$_4$ 5	1 *gur* 2 *bariga* 3 *ban* flour rations of 5 days
Cost in days: 5 days → *5* Unstated wage rate: 1 *bariga* 3 *ban* → 1:30 *5* × 1:30 = *7: 30* Cost in grain: *7:30* → 1 *gur* 2 *bariga* 3 *ban* (table of capacity)		

Table 8.25 Wage rate calculation in AO 08461

24’	4(bariga) 3(ban$_2$) še duḫ *ša* u$_4$ 1(u) kam 1 (diš)/3(ban$_2$)-ta-am$_3$	4 *bariga* 3 *ban* grain bran of day 10 1 (day) per 3 *ban*
Multiplication with stated rate: 3 *ban* → 30 (table of capacity) *10* × *30* = **5** **5 → 1 *gur* (table of capacity)**		**Multiplication with stated total**: 4 *bariga* 3 *ban* → 4:30 (table of capacity) *10* × **27** = *4:30* **27 → 2 *ban* 7 *sila* (table of capacity)**

throughout the kingdom of Larsa. In some instances, like excavation work or brick production and delivery, there are mathematical texts that describe labor and wages.[29] However, again, not all activities are described in the mathematical texts. For instance, activities described in LB 1074 and LB 1078 of the grain harvest archive are not mirrored in the mathematical texts.

8.4 Tabular Layout and Economization of Practice

LB 1074 lines 1 through 6 describes projected costs in harvesting grain: man-days labor multiplied by a wage rate produces total cost in labor for each variety of work necessary to harvest grain. These projections might be based on some form of project statement and then work assignment if it is part of a calculation similar to the cost estimate in YBC 04663, problem 1. Unfortunately, no texts describe labor out of a project statement, perhaps because such texts were redundant: the grain-rate texts associated with NBC 11509 and then the grain harvest archive state both allocated men and their costs in grain so that they sum up both steps at once. However, texts like Ashm 1923-340 of the grain production archive do describe project statements (See Sect. 4.4).

Ashm 1923-340, which was discussed in Chap. 6, certainly made use of rates to estimate yields for various tracts of land. Such projected yields would be valuable in predicting and planning for labor costs at harvest. As noted in the discussion of this text in Appendix 1.A.b, the rates themselves are stylized, based on a few numbers: 10 *gur* per 2 *bur* land, 20 *gur* per 2 *bur* land and 30 *gur* per 2 *bur* land. Because 2 *bur*, which transforms into SPVN 1, defined these rates rather than 1 *bur*, it can be suggested that these rates were based on SPVN numbers. Moreover, 10 *gur* transforms into 50 in SPVN, 20 *gur* into SPVN 1:40, and 30 *gur* into SPVN 2:30, all of which had a corresponding standard multiplication table, so that calculation of each rate would have been very easy. Thus, metrological and numerical tables were probably used in the construction of each rate.

The rates themselves presented an economic model for estimating yields and may have been incorporated in projecting labor costs at harvest. Coefficients could easily be applied to these yields to produce man-days of labor, which in turn required only grain rates to produce the amount of grain necessary to calculate costs in harvesting grain, such as those seen in LB 1074 and LB 1069.[30] This might also speak to economization of practice. Yield and harvest may have been presented with labor in the same way tax revenue was hypothetically presented with interest calculations: as a form of commentary. While the production of project statements may have differed, the production of labor and cost from these statements was probably similar. This is

[29]See Middeke-Conlin (forthcoming c) for mathematics surrounding bricks.

[30]To prove this, a text with labor rates to produce man-days of labor out of estimated yields would need to be found, a text similar to YBC 12273 for excavations.

because harvest labor, as well as excavation labor, would present performance and then cost predictions out of a project statement. Just like with interest calculations, it was simply unnecessary to present all situations in which one algorithm could be applied. Instead, a teacher needed only to provide a commentary when presenting an algorithm: After presenting an algorithm useful to calculate labor, a teacher needed only to present the applicability and then implementation of this algorithm in other environments like calculating yields and harvest, including the differences in setup, or the project statements, and in results, or costs.

If this hypothesis is followed, both canal excavation and harvest costs in labor and pay may have been calculated using a step-by-step process that is mirrored in the economic texts. Calculation on UET 6/2 233 involved a tabular format to carry out each step of its calculation. Multiplication involved the literal raising of a number to another number on these texts to produce the answers. On the left, inputs listed in the setup are placed—length, width, depth, work assignment (and its reciprocal) and wage rate. On the right, the answers to, or outputs of, each step are placed. This spatial arrangement allowed the authors to keep track of the calculation, of what step they were on, as well as the result of each step from each input needed for each step. Organization into a tabular format facilitated calculation. One wonders now whether tables could be used to explain other mathematical processes as well.

First, it must be underlined that it was the tabular layout on UET 6/2 233 that facilitated simplified calculation. The form made it easier to keep track of each step, as well as each answer. These answers were ostensibly transformed into measurement values in a different medium: either on a further tablet or orally to the teacher. Additional tables existed beyond mere lists, such as that found in tables like MS 2830 as discussed above concerning equivalencies (see Sect. 8.2.2). There, it was hypothesized that these tables, while they were used to calculate problems of 'making equal', were also used or conceptualized to calculate equivalencies in economic texts.

Taking this hypothesis further, it is tentatively suggested that these tables were also useful for expressing the algorithmic relationship witnessed in VAT 08521, problem 1, to calculate interest. That is, the problem requires first, finding the principal out of the interest, and then the very same interest out of the principal, based on the statement 12 *gin* silver for every 1 *mana* principal. To produce the interest rate meant simply to divide 12 by 1. To find the principal out of interest, the author found the reciprocal of 12, that is 5, and multiplied it by the total interest to produce the principal, 8:20. He then reversed this, finding the total interest out of the principal by multiplying 8:20 by 12, the interest rate to produce 1:40. This reversal fits the layout of tables like those found on MS 2830 quite well.

Table 8.26 helps to illustrate this hypothesis: column I states the interest rate, column II states this rate's reciprocal, column III states the principal, while column IV states the interest. Such tables would present a logical progression for VAT 08521 problem 1. The author first finds the interest rate and places it into column I, while the interest itself is placed in column IV. Next, the interest rate's reciprocal is found and placed in column II. The interest in column IV is multiplied by this reciprocal to produce the principal which is placed in column III. The operation

Table 8.26 Hypothetical tabular layout to calculate VAT 08521, problem 1

I. Interest rate	II. Interest rate reciprocal	III. Principal	IV. Interest
12	5	8:20	1:40

follows exactly what is described in problem 1 of VAT 08521. Calculation is inward in this table, inputs are placed in the outer two columns and then outputs appear in the inner two columns. This logical progression based on tables like those found on MS 2830 may help to explain why principal out of interest is requested first, and not the other way around, in VAT 08521 problem 1.

This, in and of itself, is highly speculative. However, the appearance of two rather nebulous interest statements right before statement 3 of YBC 04698 justifies this speculation. These statements, as noted in Middeke-Conlin and Proust (2014: Sect. 6 Number 1), do not state the actual problem, but are only interest statements, and may possibly refer to a prior problem or statement on a prior tablet.[31] Perhaps these two statements are building on a similar procedure as that in problem 1 of VAT 08521, while exploiting a table similar to those on MS 2830 just like those probably used by statements 3 and 4, and indeed much of YBC 04698. Similar hypotheses have been made concerning tables like those found on MS 2830. For instance, while discussing mathematical texts and education in the Old Babylonian city of Nippur, Proust (2007: 204–205) convincingly argues that similar tables were exploited to compute an area problem expressed by means of a diagram on the tablet YBC 07356.

We then see two different varieties of table used to calculate complex problems. The first was used to express a step-by-step process to project productivity and costs in labor while administering a project. These could, perhaps, be termed labor tables because the calculation of labor costs would remain the same regardless of whether the project is a canal excavation or grain harvest. The second might better be termed rate-tables, or tables that exploit a rate and its reciprocal to carry out calculation, whether these calculations are equivalencies, questions of proportionality or geometric ratios. In each table, the exact problem being solved is secondary to the table itself. Only numbers change, and they only gain value with transformation to a measurement value, and only gain purpose when associated with a mathematical problem or an economic process. Thus, we can plausibly propose that tables like those on MS 2830 could be used in multiple mathematical environments—the economization of practice described here—whether these environments were expressed in writing or orally as a form of commentary.

[31] In contrast to Neugebauer's hypothesis that these problems only asked for computation of the rates themselves, that is, for production of the SPVN value to be multiplied against the principal (Neugebauer 1935–1937 III: 43). This is also in contrast to Al-Rawi and Friberg (2016: 421) who see these two statements as 'the introductory paragraph to a theme text about a completely different topic, namely principal and interest', and interpret the purpose of these statements as to produce the sum of principal plus interest (*ibid*.: 422).

8.5 Conclusions

This chapter entered into a discussion of rate-calculations and estimation. At the onset of this chapter, while discussing revenue calculation, it was noted that there seemed to be an economization of mathematical practice between professional environments. Under this hypothesis, mathematical practice in professional environments built on algorithms or their components presented on mathematical texts of the late elementary or early advanced scribal education. Discussing revenue, it was noted that tax rates, change rates, as well as conversion rates, had the same basic procedure as interest rates, so that practice surrounding each may have been taught via a kind of commentary when interest calculation was learned. In the same way that estimation by means of multiplication built on components presented through metrological and numerical tables with the elementary scribal education, so did practices typical of professional environments build on algorithms taught or presented late in the elementary education or early in the advanced scribal education.

The importance of metrological and numerical tables in defining practice emerged especially clearly in relation to equivalencies. Equivalencies appear throughout Larsa's history in the Old Babylonian period and were exploited by numerous merchants, although provenance is difficult to ascertain for those merchants outside of Larsa. YBC 04224 shows that calculation of equivalencies was performed in the early Old Babylonian period. SPVN seemed to be a factor in each discrepancy studied here, and in the production of each equivalency. Indeed, with YBC 04224, it was shown that by truncating 7 *sila* from the total sesame, the number of numerical tables needed to carry out calculation in SPVN dropped from four to three. Truncation simplified calculation. SPVN helped to explain the discrepancy in NBC 08014, where the scribe probably rounded up by 1 in SPVN, from 3:39 to 3:40, rather than up by 3 *še*, from 3 1/2 *gin* 27 *še* to 3 2/3 *gin* in order to simplify transformation between SPVN and measurement values.

SPVN was probably used to make the equivalencies seen in YBC 07473 as well. Calculation of a rate in which a non-regular number was a factor suggests that the author of this text was familiar with approximate reciprocals to these numbers such as those found in M 10. The reciprocals in M 10 are, moreover, all written in SPVN. The author's mistake in rounding this value seems to stem from his desire to offset roundoff error in his approximate reciprocal. He rounded up rather than down, compounding the discrepancy inherent in approximation. How he rounded up is of greater interest. He seems to have rounded up based on entries as found in metrological tables. The metrological tables he learned in the elementary phase of the scribal education, then, probably influenced how this scribe perceived and then rounded values. These tables defined acceptable measurement values.

The remaining equivalencies in the capital section of YBC 07473 also suggest the author was using SPVN because 10 was the SPVN transformation of four out of five in-kind capital expenditures. This speaks for conformity as discussed in Chap. 5, which is supported by Appendix 4. The charts in this appendix suggest

that in many instances prices, when defined by equivalency rates, were produced based on just a few SPVN numbers. Indeed, the limited number of numerical tables necessary to calculate equivalencies in each text studied here, from one to three tables per rate, suggests that calculation in SPVN would have been very simple for these scribes if they had been through a scribal education that incorporated these tables in its elementary stage. YBC 07473 shows that, as long as scribes practiced with non-regular numbers and their reciprocals, equivalency rates could fluctuate beyond these standard values when needed. Some reality is necessary for fixed rates to be acceptable. However, conformity of capital disbursements based on SPVN could have made it easier to cope with this fluctuation, at least from an administrative perspective. While rates may have fluctuated from year to year in YBC 07473, the multiplication table needed to make each equivalency remained the same. Thus, from equivalency rates to capital disbursements, scribes conceptualized value based on metrological and numerical tables learned in the elementary phase of education. Rounding in these equivalencies was performed for several reasons: to produce a more certain value, to simplify calculation with SPVN and to simplify transformation from SPVN.

Mathematical texts used SPVN to calculate variable market rates which, in the process, exploited basic equivalencies. YBC 04698, statement 3, as well as purely numerical tables like those found on MS 2830, which may have been part of an advanced scribal education, offer evidence for how the scribes conceptualized equivalency calculation, even if the mathematical processes expressed in this text, and then in the table, do not reflect reality. Indeed, mathematical texts like YBC 04698, statement 3 and numerical tables like MS 2830 may have helped the aspiring scribe to understand the numerical relationships that existed when making equivalencies, while the tables could have produced a visual model for how to make equivalencies because of the relationships that existed between columns. If these texts were not part of an advanced scribal education, it may be suggested they exploited practice as learned in a scribal education to produce mathematical problems. Thus, these equivalencies offer evidence for the importance of elementary education, as well as the importance of an advanced scribal education, whether this education occurred in a classroom environment or a professional setting.

Labor and wage rates used to estimate value are present in numerous mathematical and economic texts from the Old Babylonian period and thus played a significant role in the economy of the kingdom of Larsa. As is shown with YBC 04663, YBC 04666 and UET 6/2 233, labor was calculated out of an initial project calculation, such as an estimation of volume to be excavated from a canal. Labor rates were used to project the man-days necessary to complete this project, while wage rates were used to assess man-days of labor in a quantity of grain in YBC 04666 or silver in YBC 04663.

Each step described in YBC 04663 problem 1 was reflected in texts from the bureau of irrigation and excavation, where a volume was calculated in NBC 11509, NBC 06763 and YBC 12273 for various canal excavation projects. Labor was calculated out of this volume in YBC 12273, while wages were estimated out of labor in Riftin 1937: no. 116. Thus, this bureau shows that the mathematical

tradition reflected an administrative reality. With NBC 06763 of the bureau of irrigation and excavation, it was suggested that labor rates could also be used to assess excavated volume after a project was completed. Five out of six volume measurement values presented in NBC 06763 were not produced by a multiplication of length by width by depth, as witnessed in the texts. Problem 7 of YBC 04663 did calculate volume out of wages paid using wage and labor rates in pursuit of a further calculation. Volume was also computed out of a quantity of men and a labor rate in Riftin 1937: no. 117 and BM 016391. Thus, with NBC 06763 it was suggested that volume was assessed by means of multiplying total wages by the reciprocal of the wage rate to produce total labor and then this labor was assessed by a labor rate to produce an estimated volume which described a completed excavation. This would mean that volumes stated for each excavation in NBC 06763 were based on observations of labor and not on observations of length, width and depth. Interestingly, the subtotal and total volume in this text were not the sum of volumes stated in this text but seem to refer to an earlier text which estimated volume based on the stated length, width and depth on the text. Truncation of the added values used to produce this total suggested that addition was carried out using a counting device similar to that seen in Chap. 6. Limiting granularity to one-6th *sar* also suggested that the scribe may have been familiar with measurement inconsistency as described in Chap. 7. This would suggest an elementary scribal education as described in Chap. 2.

However, the labor rates in YBC 12273 reflected some deviation from the mathematical tradition: the depths to which each labor rate corresponded differed from the depths in YBC 07164. In addition, while YBC 04663 problem 1 states length as 'us_2', it is listed as 'gid_2' in NBC 11509. Finally, a centesimal system was used in the wage rate texts which, as stated in Chap. 2, was uncommon in the kingdom of Larsa but common in northern Babylonia. This shows that, as with equivalencies and tax revenue calculations, the bureau of irrigation and excavation relied on a basic scribal education as well as a limited practical knowledge acquired in some form of professional education. This would help to support Michalowski's assertion that much scribal education occurred outside of the school and in a professional setting (Michalowski 2012). Indeed, this assertion is confirmed by the texts BM 085211 and BM 085238, both believed here to be examples of an advanced, professional education. These educations show some variety as well, reflecting different microcultures in so far as excavations are concerned.

Because it is dated and shows a clear rate, Riftin 1937: no. 116 of the bureau of irrigation and excavation was used as an initial example of wage rates. YBC 04663 also showed how wages were calculated. Standard wage rates were exhibited in assessing wages out of a quantity of men or man-days of labor. Riftin 1937: no. 116 and Ashm 1922-281 suggested that this procedure was probably used to calculate wages in the bureau of irrigation and excavation.

This same variety of calculation was witnessed in LB 1074 and LB 1078 of the grain harvest archive, where costs in harvesting fields were assessed. In both LB 1074 and LB 1078, wages, assessed by wage rates, were calculated and then added together, showing that an estimation of labor costs in grain was carried out. The

rates used in LB 1074 and LB 1078 served to define values. The calculation of wages was also assumed in Ashm 1923-315, where no wage rate was provided, although this could easily be reconstructed. This seems to contrast with AO 08461, where it was shown that the stated rate was probably a rounded value. For AO 08461, the rate was only a guideline, of secondary importance to the text. Thus, wage rates were not limited to environments witnessed in the scribal curriculum, but were computed to estimate grain in other areas, like agricultural activity. Indeed, it was hypothesized that the planners of the grain harvest archive would have planned harvest activity using texts like Ashm 1923-340 from the grain production archive to produce project statements. Harvest costs from yield estimates could have been explained when labor calculation was learned as a form of commentary. Mathematical practice with the grain harvest texts, then, probably built on practice presented in the scribal curriculum, again providing evidence for the economization of practice hypothesized here.

Tables as a medium for organizing data to facilitate computation may have also served as a focus of commentary. Thus, a teacher could present a problem on interest and at the same time show its applicability for calculating both taxes and standard conversions based on sampling with a table that was common for expressing equivalency rates. By means of a table, a teacher could also show a student a step-by-step process to plan an excavation and then isolate a part of this process and show its applicability elsewhere: the wage rates calculations that were used to project costs in harvesting grain.

The prospect of commentary could mean that much of the scribal curriculum was not written down, and that some education occurred in a professional environment. Commentary could occur in any environment, so that the teacher needed only to be familiar with an algorithm in order for commentary to be effective. Such commentary in a professional environment may have prompted the composition of the apprenticeship texts, BM 085211 and BM 085238. Indeed, such commentary probably inspired the production of purely numeric tables such as MS 2830 and UET 6/2 233. The very lack of a stated setup in these texts would seem to attest to this, whether the teacher referred to notes for his commentary or not. The applications of these texts are vague precisely because the problem setup was conveyed orally. Conformity across milieus was probably produced out of values and numbers presented with the metrological and numerical tables during the elementary scribal education, as well as the economized mathematical practices encountered in the advanced scribal education.[32]

[32]Friberg (1981: 63) presents a similar hypothesis on the applicability of algorithms, where he states concerning IM 52106, ‘Remarkably enough, however, the values of the coefficients A and B are not specified in any of the equations on IM 52106, possibly in order to give the instructor more freedom to choose his own examples’. The freedom of an instructor to produce problems outside of those witnessed in a text, with different inputs—coefficients A and B in Friberg’s example—but using the same basic algorithm, points to the importance of an instructor’s prerogative in presenting the scribal curriculum, as well as the potential for commentary in applying basic algorithms to different contexts.

Conformity based on economic models was probably important. As was seen especially for the bureau of irrigation and excavation, when estimating costs in capital and labor, expected values would differ from actual values. Error with each becomes apparent with measurement: Because observational errors were recognized to exist, uncertainty in measurement led to uncertainty in each estimation. Earth to be excavated was possibly assessed before an excavation in NBC 11509. Costs in labor were also estimated in YBC 12273. Wages were estimated in Riftin 1937: no. 116. These texts were predictive, stating what was expected. For both YBC 12273 and NBC 06763, however, estimated volume did not reflect reality. The scribe who estimated volume in YBC 12273 produced clearly stylized estimations of volume that could not reflect reality. The scribe who produced NBC 06763, if this text is properly understood, was probably aware that estimates like those produced in YBC 12273 could not reflect reality because costs in labor were used to observe how much earth was actually excavated in this text.

Economic models, as present in or adapted from the scribal curriculum, were probably important—whether these models were in pursuit of conversions, revenue, equivalencies, labor or even yields. These models are perhaps similar to conceptual errors as outlined by Allchin (2001: 8) except that scribes were aware of the limits of their models and so acted to offset these limits. They produced accepted practices for estimating value. Asper's points concerning the use of an approximation by ancient Greek officials estimating area are equally applicable here: 'the error is a 'false' one, because it is socially established as acceptable in those groups that decide ex officio about truth, or rather, about successful problem-solution' (Asper 2012: 54). In the examples provided here, the group establishing 'successful problem-solution' is the instructors, both in a classroom setting and in a professional environment. With the economic models they presented, an actor could enter into the unknown with limited risk. Culpability for error would have been limited. The author was probably aware of error, or at least the potential for error. This is seen with labor and wages, equivalencies, revenue and standard conversions. Whether error was acceptable or not, the very existence of these models suggests that the authors wanted to limit error. In each case, practice was formed to limit culpability and now it must be asked how potential error was limited.

Chapter 9
Rounding in Mathematical and Economic Texts

Abstract This chapter sums up evidence for rounding numbers. Value and number approximation are shown to have been fostered, learned and reinforced in the elementary scribal education and in the different advanced scribal educations that are hypothesized throughout this volume. Rounding occurred for several reasons. Truncation could occur because each added value was limited based on the size of an abacus or some other counting device as seen in Chap. 6. Truncation could offset measurement inconsistencies, as explored in Chap. 7. Rounding could have simplified calculation with sexagesimal place value notation or, as seen in Chap. 8 in the case of calculation by non-regular numbers, it could even have made this calculation possible. In every instance, a probable or at least plausible logic is shown at play while rounding numbers. A third kind of error, systematic error, is also suggested, so that three kinds of errors existed in the texts: observational, conceptual and systematic errors. Scribes were aware of each kind of error and used rounding to offset these errors. Rounding was based on customs and practices that were put in place to deal with the uncertainties inherent in their systems of quantification and calculation so that scribes could administer the economy with limited risk and culpability.

Numbers were rounded throughout the early Old Babylonian period and throughout the kingdom of Larsa. Examples of rounding were discussed in the previous chapters, while mistakes, errors and estimation were explored in relation to the economic texts. The earliest text examined here, YBC 04224, dated to *Gungunum* of Larsa, probably from around the city of Larsa itself, rounds off 7 *sila* grain from the total amount of oil. This produced a 0.02 per cent difference which appeared subsequently in the silver equivalent of this total. The latest example of an explicit rounded value in an economic text occurs in Ashm 1923-340, a tabular text dated to *Hammu-rābi* of Babylon's thirty-fifth year and describing activity around the ancient city of Ur. This text rounded 5 *ban* up to 1 *bariga* to produce a 0.08 per cent difference. See Appendix 5.B.c and 5.B.b for distribution of rounding by year and provenance respectively. How was rounding expressed in the scribal curriculum

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and mathematical tradition? How was rounding adapted to the economic texts? What deviations were acceptable?

As stated in Chap. 1, mistake and error are two different things. Mistakes result from a lapse of judgement and are unintentional deviations from rules or practices. Error is not a deviation from a rule nor the result of a lapse in judgement because it explores the unknown, the potential. However, both mistakes and error produced a difference between expected and stated value. Words such as 'discrepancy' and 'per cent difference' are used to describe this deviation between expected and stated value to avoid describing this deviation as an error or a mistake. Stating a per cent difference is also important because, as noted in Chap. 7, a five to six per cent variance was tolerable as far as evidence from extant weight stones suggest. Moreover, some variation was visible when assessing capacity before and after shipment in Chap. 7, as well as volume in an excavation in Chap. 8. Thus, variance was expected in measurement.

In Chap. 7, the metrological lists and tables became important. It was shown there that these lists defined acceptable granularity of measurement values. This acceptable granularity was associated with SPVN numbers in the metrological tables and, as shown in Chap. 5, the numerical tables created standard building blocks used to calculate in SPVN. The acceptable granularity became especially important with both truncation associated with measurement inconsistency as well as truncation associated with the use of an abacus or other counting device. The standard building blocks became important with estimations, including revenue, equivalency and then labor and wage calculations.

With texts like YBC 04669 problem 9, discussed in Chap. 7, granularity is important as well. This text presents one of the few examples of rounding in a mathematical text. In problem 9, 2/5 *šusi* was rounded off 3 9/10 *šusi* to produce 3 1/2 *šusi*, a calculated value. 1/2 *šusi* is not on any metrological list. However, the author uses the typical 1/2 sign rather than produce a complex and transparent fraction, suggesting that he is not interested in producing an exact value, only a close approximation. Indeed, as became evident with YBC 04607, masters had difficulty expressing measurement values below the values present on metrological lists and tables, while the student exercises presented in Chap. 7 showed difficulty transforming SPVN to measurement values when they went below these lists. The metrological lists and tables certainly affected how students and masters presented measurement values, and also how they rounded these values.

Perhaps a similar phenomenon appears with BM 085238. This text, hypothesized to be an apprenticeship text, exhibits an example of rounding up, from 5 1/2 *sar* 7 2/3 *gin* to 5 2/3 *sar*, showing that rounding numbers was taught in the bureau of irrigation and excavation. This rounding, which results in a marginal difference, is possibly based on metrological tables and is, perhaps, due to a split in the volume system. As emphasized in Chap. 6, these splits were exploited while carrying out calculation with a tool such as an abacus. At and above 1/3 *sar*, measurement values took on the system for area and volume, while at and below *gin*, the system used was the weight system. Perhaps at this level of the apprenticeship, the scribe found it easier to transform a complex SPVN number into its measurement value

based on this split as well. It was simply easier to round up when transforming numbers. This is confirmed to some extent by the difficulty this scribe had in transforming SPVN to measurement values. The author generally had trouble transforming SPVN into *iku* measurement values even if he could transform *sar* measurement values correctly. Perhaps rounding here shows trouble transforming SPVN to measurement values below *sar* as well. In any event, transformation was a difficult skill to learn. It required familiarity with numerical systems and the metrological lists as well as understanding how SPVN worked. Transforming numbers into values that were not on the lists was difficult, and so were transformations to values that departed from a sexagesimal structure. Rounding was a tool to simplify transformation in these instances.

In addition to rounding values up or down based on metrological lists and tables, mathematical texts also show a need to round numbers when dividing by non-regular numbers. This was pointed out while discussing YBC 07473. Non-regular numbers posed a problem for the Old Babylonian scribe, and this is underlined by YBC 04698, statement 14. This statement shows practice with the reciprocals of non-regular numbers while calculating equivalencies. Although there is no question in statement 14 of YBC 04698, there is an implied problem similar to that suggested by statement 3 presented in Chap. 8. The purpose of statement 14 is to find each quantity corresponding to an in-kind rate, stated as 1 through 9, and for which the total would be 1 *bariga*. However, evaluation of each non-descript commodity is in grain, not in silver as in statement 3. Nor could the solution be the same as that proposed for statement 3 because the one in-kind rate is 7, a non-regular number in SPVN. Thus, this text presents a problem with non-regular numbers while evaluating commodities in grain.

The solution to statement 14 is probably similar to that of VAT 7530 problem 5, first presented by Neugebauer (1935–1937: I 288) and later discussed by Friberg (2007: 166), and uses tables similar to that found in N 3914. Each in-kind rate, from 1 to 9, is placed in the first column of the table. A false value, following Friberg's solution for VAT 7530, is probably provided for each commodity, similar to those false values provided in N 3914, a multiple of 7 (cf. Friberg 2007: 163–65). Thus, each commodity would be assigned a false number which is the product of each in-kind rate's reciprocal multiplied by 7. These were placed in column II. The total of column II is 19:48:10, which rounds up to 20. This is approximately a third of the total purchase, 1 *bariga* or 1 in SPVN, so that the in-grain value of each commodity is column II multiplied by the coefficient 3. These numbers are each placed in column III. The total of column III is 59:24:30, which rounded up to 1. As with statement 3, the in-kind value made equal is the product of column I, the in-kind rate, multiplied by column III, the in-grain value, or 21. The solution therefore requires the use of a rounded approximate number, that is, a number rounded up to a number found on the multiplication tables and memorized in the course of the elementary phase of the scribal curriculum. This rounding produced a difference of 0.996 per cent (Table 9.1).

The numerical tables as memorized in the elementary scribal education would have been important in producing false values in general, and rounded numbers in

Table 9.1 YBC 04698, statement 14, proposed solution (After Middeke-Conlin and Proust (2014 Chap. 6, Number 14))

1 *bariga* → 1 (table of capacity)				
	I	II	III	IV
	In-kind rate	False in-grain value (reciprocal of I × 7)	In-grain value (II × 3)	In-kind value (I × III)
Good 1	1	7	21	21
Good 2	2	3:30	10:30	21
Good 3	3	2:20	7	21
Good 4	4	1:45	5:15	21
Good 5	5	1:24	4:12	21
Good 6	6	1:10	3:30	21
Good 7	7	1	3	21
Good 8	8	52:30	2:37:30	21
Good 9	9	46:40	2:20	21
Expected total	45	19:48:10	**59:24:30**	3:9
Rounded totals		20	1	
Difference		11:50	35:30	

particular. As seen throughout this volume, they were designed to produce numbers that could easily be manipulated, based on the numerical tables as memorized in the scribal curriculum discussed in Chap. 2.

Approximation by means of rounding was probably used to solve statement 14 in YBC 04698. The tablet M 10 discussed in Chap. 8, as well as YBC 10529 also made use of approximations (Neugebauer and Sachs 1945: 16). YBC 10529 is an unprovenanced tablet that presumably lists reciprocals to all numbers from 1 to 1:20, including approximations to the reciprocals of non-regular numbers. However, numbers only extend to four place values, so that it is evident that the scribe truncated numbers to a point which made them easier to handle. By truncating numbers, the scribe rounds off the numbers to the fourth place value, producing numbers that allowed for easier manipulation than would have been possible without such a truncation. Truncation, then, is a means to approximate a number by means of rounding off or removing parts of this number. YBC 10529 showed that these reciprocals were explored in an academic setting, either by a student, a master or both.

Approximation of some sort was necessary for the Old Babylonian scholar as well as any scribe who needed to work with non-regular numbers because, in order to divide a number, the scribe had to multiply by a number's reciprocal. The scribe first found the reciprocal of a number, either one memorized on a list in school or by means of a reciprocal extraction exercise in order to set up multiplication (see UET 6/2 295 in Appendix 1.B). The multiplicands used to set up this multiplication

would need to consist of elements present on the multiplication tables memorized in the elementary education. To this end, the scribe needed to work with finite numbers as multiplicands. Thus, the reciprocal that would be used as a multiplicand had to be finite. However, as Høyrup notes, there is no concept of periodicity, nor should one be expected. Discussing periodicity, Høyrup (2002: 297) states:

> The calculation of the igi of an irregular will be cyclical, and the corresponding sexagesimal number periodical; square-roots of non-squares are not. We have no evidence at all, however, that the Old Babylonians were alert to this fact or interested in it; nor is there the least reason that they should have been forced to discover the basis for periodicity (namely, that the number of possible remainders is finite).

Discussing M 10, Høyrup states all reciprocals in text M 10 are 'interrupted before exhibiting periodicity' (*ibid.*: 197, note 339).

To the Old Babylonian scholar and practitioner, periodicity was not perceivable because with base 60 the period can be as long as 60 places. What the ancient scribe understood is that some numbers were unwieldy at best and required methods to get around them, such as the use of false values or approximate reciprocals. Gaining familiarity with particular numbers was regarded as especially important. The text M 10 explored the numbers 7, 11, 13 and 14, while 7 is the only number on M 10 provided with two approximate reciprocals, betraying its exceptional importance in the mind of the Old Babylonian scholar who produced this text. These approximate reciprocals are not found on the standard reciprocal tables as discussed in Chap. 2, and may consequently have fallen outside of the memorized elementary curriculum. Thus, if the Old Babylonian scribe memorized these reciprocals, it either occurred late in the elementary education or in an advanced education of some form when he practiced with other methods to deal with non-regular numbers, such as the false values used in YBC 4698 statement 14, N 3914 and VAT 7530.

Value and number approximations such as these, which are errors inherent in the numerical system or calculation system, may be called systematic errors. Similar errors can be witnessed in other mathematical environments. Brunke (2012) presents an argument for the approximation of the number pi as a means to assess the area of a circle. To Brunke, an approximation of the number pi can be made in three ways, each of which has its own sophisticated logic behind it, and each could well be used in mathematics to produce a valid, if approximate, measurement value. Fowler and Robson (1998) show this as well with the curricular setting for approximations of square roots, so that mathematical approximations were probably learned in the course of a scribe's education. These systematic errors, then, are valid methods of practice that were fostered, learned and reinforced in the elementary scribal education and in the different advanced scribal educations hypothesized throughout this work—all 'false' errors as described by Asper (2012). Does rounding in the economic texts reflect value and number approximation as fostered, learned and reinforced in the scribal educations?

9.1 Truncation of Measured and Calculated Values in Administrative Texts

When reciprocals are approximated in text M 10, they produce an error that is recognized by the scribe. Indeed, as pointed out with YBC 07473 discussed in Sect. 8.2.3, the scribe possibly rounded after computation in order to offset the roundoff error produced by this approximate reciprocal. This is an important consideration because it not only shows that at least some scribes were aware of this form of error but also that they attempted to cope with approximation by rounding values in order to limit discrepancy. This seems a plausible conclusion both because M 10 stated what the nature of error is and because YBC 07473 seems to express a rounded value both before and after computation.

Discussing the grain storage bureau in Chap. 7, it was proposed that rounding by means of truncation was an important method to offset measurement inconsistency. This suggests that additional texts may have offset measurement inconsistency by means of truncation. There is also evidence for explicit rounding by means of truncation of an added quantity. Table 9.2 summarizes these by metrological system. Table 9.2 lists texts by measurement system and then by scribe. Each text listed in Table 9.2 removes the lowest component(s) of a measurement value from an added total or subtotal. This often produces a marginal difference. Indeed, in all texts except YBC 08758, truncation produces a difference of less than one per cent. In several values, rounding up could reasonably be expected. This is the case with 7 *sila* in YBC 04224, which could easily round up 3 *sila* to 1 *ban*, as well as 5/6 *sar* in Ashm 1922-290 which could easily round up one-6th *sar* to 1 *sar*. Rounding up in each of these cases would have produced a smaller difference. However, several factors could easily influence rounding by means of truncation.

As shown in Chap. 6 when discussing YBC 04224, a calculation instrument could have been used. In this scenario, each added value was limited, based on the size of an abacus or other counting device. This was also proposed for NBC 06763, where each value was truncated to sixths of a *sar* due to the limited size of a calculation device. Thus, after calculation, 2/3 *sar* 6 *gin* one-4th *gin* is missing from the total. A counting device was also suggested for LB 1075 in Chap. 7, where the author stated measurement value to whole *sila*, the lowest stated value on the texts, so that while he could calculate a remeasured value using a sample measurement and change rate to finer granularity after transformation from SPVN, he truncated this calculated value to *sila* based on the limits of a counting device.

Rounding up would also defeat the purpose of truncating value, which is to offset apparent measurement inconsistency. That is to say, variance could be expected between measurements. With this in mind, the removal of the lowest measurement values, even in an added total and even with values higher than we may expect, makes sense. The author of each text may have been well aware of what errors could be expected and, rather than state an exact total, may have preferred a more certain total. Indeed, with the value just cited in LB 1075, the sample measurement the author took may have been truncated to *sila* as well, this

Table 9.2 Truncation and difference of added values

I. Text	II. Stated value	III. Expected value	IV. Truncated amount	V. Truncated below	VI. Per cent difference (%)	VII. Scribe
YBC 04224	2 × 60 + 20 *gur*	2 × 60 + 20 *gur* **7** ***sila***	7 *sila*	*gur*	0.02	Scribe A
Ashm 1922-281	28 *gur* 2 *bariga*	**24** *gur* 2 *bariga* **1** ***ban***	1 *ban*	*bariga*	0.14	*Nabi-Šamaš* A
Ashm 1932-378	47 *gur* 1 *bariga* 4 *sila*	47 *gur* 1 *bariga* 4 *sila* **[x *gin*] 5 *še***[a]	[x *gin*] 5 *še*	*sila*	up to 0.002	*Šēp-Sîn* A
YBC 07183	1 *bariga* 1 *ban* 8 *sila*	1 *bariga* 1 *ban* 8 **1/3** *sila*	1/3 *sila*	*sila*	0.43	Scribe H
LB 1075	3 *bariga* 2 *ban* 5 (*sila*)	3 *bariga* 2 *ban* 5 **1/3** *sila*	1/3 *sila*	*sila*	0.16	*Sîn-iddinam*
LB 3051	3 *bariga* 5 *ban* 5 *sila*	3 *bariga* **3** *ban* 5 *sila* **5 *gin***	5 *gin*	*sila*	0.38	*Aḫūšunu*
YBC 08758	11 *gin*	11 *gin* **one-4th**	One-4th *gin*	*gin*	2.22	*Gimillum*
NBC 06339	29 *sar* bricks	29 *sar* **7** bricks	7 bricks	*sar*	0.034	*Lu-igisa*
NBC 06763	4 *iku* 26 *sar* 10 *gin*	4 *iku* **16 5/6** *sar* **6 *gin* one-4th *gin***	2/3 *sar* 6 *gin* one-4th *gin*	*gin*	0.0018	*Immer-ilī*
Ashm 1922-290	1 *bur* 4 *iku* 15 *sar*	1 *bur* 4 *iku* 15 **5/6** *sar*	5/6 *sar*	*sar*	0.038	Uncertain, no date
Ashm 1922-290	5 *bur* 2 *iku* 1 *ubu iku* 29 *sar*	5 *bur* 2 *iku* 1 *ubu iku* 29 **1/2** *sar* **5 *gin***	1/2 *sar* 5 *gin*	*gin*	0.006	Uncertain, no date

[a]Unfortunately, the text is broken and so is not fully treated here. If line 3 is correctly restored as 3(u) 1(aš) 4 (bariga), when computation is completed a minimum of 5 še grain is removed from the subtotal in line 9 and subsequently the total in line 21. However, the traces before 5 še in line 5 suggest more was removed. This suggestion is quite plausible. If only 5 še was rounded off then the per cent difference between the expected value and the extant value in line 09 is 0.0002 per cent, while if it were 19 gin_2 5 še, the highest likely amount based on metrological tables (after this it would be expressed as 1/3 *mana*, not *gin*), then the difference would be 0.002 per cent. In either case, the value which would be rounded off the total is negligible

time in order to offset measurement inconsistency. Thus, he seems to have decreased granularity in preference to a more certain value, just as the actors in the grain storage bureau seem to have done. Truncation in each of these texts was acceptable because of measurement inconsistency. As a result, the stated values may have resulted from both truncation of a measured value and truncation based on preference determined by the limited space on an abacus.

9.2 Other Examples of Rounding Down in the Economic Texts

Truncation was not the only method of rounding evident in the economic texts. Scribes rounded up and down based on their own needs or preferences. A look at Appendix 5.A.b shows that while there are eleven examples where a number is rounded down by means of truncation, there are three occurrences of a measurement value being rounded down to a lesser measurement value or magnitude, while there are eight occurrences of a value being rounded up to a greater value or magnitude.

Appendix 5.B.e shows that rounding, whether up, down or by truncation, occurred in thirteen totals and three subtotals, all of which suggest rounding was carried out in pursuit of, or after, an additive process. Moreover, rounding occurs in one difference and one remainder, which suggests rounding was carried out in pursuit of, or after, a subtraction. Finally, one rounded value appears in an in-kind value, one in an in-silver value, one in a change rate calculation and one as a rate. These last four instances suggest that rounding was carried out during or after a multiplication. The remainder of the chapter will explore rounding in each of these processes. First, Table 9.3 summarizes rounding down added values other than by truncation.

In these texts, rounding down seems to have had more to do with what standard numerical values a bureau or individual preferred to deal with than with reducing measurement inconsistency. Thus, for instance, in the case of the text on Ashm 1923-311 dated to *Hammu-rābi* year thirty-two and part of a grain production archive of uncertain provenance, the unnamed scribe who produced this text may have rounded down 2/3 *sila* to 1/2 *sila* because he preferred to work with 1/2 *sila* measurement values. In the case of AO 07034, reduction is from 26 *še* to 15 *še* for potentially the same reason: 15 *še* was a standard value the scribe preferred to work with. This can be posited for NBC 05474 with brickage.

Table 9.3 Rounding to lower value after addition or subtraction

I. Text	II. Stated value	III. Expected value	IV. Difference	V. System	VI. Per cent difference	VII. Scribe
Ashm 1923-311	6 × 60 + 11 *gur* 4 *bariga* 1 *ban* 5 1/2 *sila*	6 × 60 + 11 *gur* 4 *bariga* 1 *ban* 5 **2/3** *sila*	One-6th *sila*	Capacity	0.0001	Scribe O
AO 07034	1/2 *mana* 1 2/3 *gin* 15 *še*	1/2 *mana* 1 2/3 *gin* **26** *še*	11 *še*	Weight	0.19	*Sîn-māgir* A
NBC 05474	47 2/3 *sar*	47 **5/6** *sar*	One-6th *sar*	Brickage	0.34	*Lu-igisa*

Perhaps preference for some of these values was based on underlying SPVN numbers rather than on the stated measurement values. This was posited in Chap. 5 as a possibility for YBC 06216, perhaps from the grain storage bureau, where an expected 52 *gur* appears as 54 *gur*. It was noted there that 52 *gur* transformed to 4:20, a non-regular number, while 54 *gur* transformed to 4:30, a regular number, so that the scribe in question might have anticipated using the total in a calculation later. When each rounded value in these texts is transformed into SPVN, numbers appear as seen on Table 9.4.

With AO 07034, reduction in value could simplify calculation. Note that 26 *še* transforms to 8:40, which requires two tables, a table for 8 and a table for 40, to multiply. 15 *še* transforms to 5 in SPVN, which would only require one table, the table for 5, to multiply. Multiplication is simplified with this reduction.

It is difficult to suggest that Ashm 1923-311 was rounded down based on an SPVN number instead of the measurement value. The same can be said for NBC 05474. Tables for 40 and for 50 respectively did exist in the standard curriculum as visible at Nippur and elsewhere, so that the choice of one over the other makes little sense. Moreover, on the standard metrological lists 2/3 *sila* is present at Nippur and Larsa while 5/6 *sar* is present at Nippur alone and would probably have been memorized in most locations in the course of the scribal education. Thus, rounding seems to have been one of simple preference—each scribe, scribe O for Ashm 1923-311 or *Lu-igisa* for NBC 05474, simply preferred to round to these values.

Ashm 1923-311 is attributed to an unnamed scribe of a grain production archive and it is thus difficult to say more about this scribe's preferences as to rounding. However, NBC 05474 is attributed to *Lu-igisa* who was active around Larsa during the reign of *Sūmû-el*. Of the texts attributed to him by Walters (1970), there are five texts dealing with volume or brickage, three of which partition *sar* measurement values into fractional values (Table 9.5).

While there are not nearly enough texts to state with any certainty what values *Lu-igisa* preferred in totals of volume or brickage, both of which are measured in *sar*, there is an additional example of 2/3 *sar* as well as one example of 1/2 *sar*, but no examples of 5/6 *sar*. He could control totals, while he could not control values used to produce these totals, as is clear with NBC 06339, which exhibits two examples of 5/6 *sar* as entries in producing the total of 29 *sar*. Thus, it can be

Table 9.4 Values rounded down in sexagesimal place value notation

I. Text	II. Stated values SPVN transformation	III. Expected values SPVN transformation	IV. Difference in SPVN	V. System of transformation
Ashm 1923-311	30:59:15:30	30:59:15:**40**	10	Capacity
AO 07034	31:45	31:4**8:40**	3:40	Weight
NBC 05474	47:40	47:**50**	10	Brickage

Table 9.5 Texts dealing with volume or brickage in the *Lu-igisa* archive

I. Text	II. Stated value	III. Expected Value	IV. Difference	V. System
NBC 05410[a]	38 2/3 *sar*	38 2/3 *sar*	–	Volume
NBC 05506[b]	3 *iku* 30 1/2 *sar* 2 1/2 *gin*	3 *iku* 30 1/2 *sar* 2 1/2 *gin*	–	Volume
NBC 05474	47 2/3 *sar*	47 **5/6 sar**	One-6th sar	Brickage
NBC 09050	1 *eše* 4 *iku* 1 × 60 + 34 *sar*	1 *eše* 4 *iku* 1 × 60 + 34 *sar*	–	Brickage
NBC 06339	29 *sar*	29 *sar* **7 bricks**	7 bricks	Brickage

[a]Walters (1970: no. 83)
[b]Walters (1970: no. 88)

plausibly suggested that *Lu-igisa* preferred to work with thirds and halves of *sar* rather than sixths of *sar* and consequently, when possible, he rounded to the nearest third or half. It must be underlined that this produced a very small difference of 0.34 per cent. It was possible to round down because rounding down to 2/3 *sar* produced an acceptable deviation in value. Rounding is potentially due to conformity in this archive but based on measurement values and not SPVN numbers.

9.3 Rounding up in the Economic Texts

Rounding up was also important. One interesting aspect of Appendix 5.A.b is the per cent differences it shows that are produced by rounding. When rounding down by truncation or otherwise, per cent difference is typically less than one per cent. Only one example, YBC 08758, produced a rounded value above one per cent, at 2.22 per cent. Of the nine values that are rounded up, four produce a difference greater than one per cent. Rounding up seems to have produced greater differences. Why was this? Focus here is again on added or subtracted values to help answer this question. Of the nine values rounded up as seen in Appendix 5.A.b, five round to a higher value with addition or subtraction while three of these five, that is, Ashm 1923-340, YBC 05494 and LB 1072, decrease granularity. Table 9.6 shows a breakdown of these five rounded values.

Table 9.6 is similar to Table 9.3 except that all values are rounded up and the placement of each rounded value in the texts is stated in column VI. YBC 05494 and LB 1072 are the only rounded values studied here that occur as the result of a subtraction. Both texts work in capacity. Both texts, as Appendix 5.B.d shows, appear on balanced accounts and reflect either a difference between what was sent and what was delivered (YBC 05494) or capital and disbursements (LB 1072). The appearance of rounded values in both texts suggests that a subtraction was actually

Table 9.6 Rounding to higher value after addition or subtraction

I. Text	II. Stated value	III. Expected value	IV. Difference	V. System	VI. Placement	VII. Per cent difference	VIII. Scribe
YBC 05494	11 *gur* 4 *bariga* 1 *ban*	11 *gur* 4 *bariga* **6 sila**	4 *sila*	Capacity	Difference	0.11	Uncertain
LB 1072	3 *ban*	2 *ban* **9 1/2 *sila***	1/2 *sila*	Capacity	Remainder	1.7	Scribe J
Ashm 1923-340	37 *gur* 1 *bariga*	37 *gur* **5 *ban***	1 *ban*	Capacity	Total	0.01	Scribe P
AO 08524	1 *bariga* 3 *ban* 5 *sila*	1 *bariga* 3 *ban* **4 *sila***	1 *sila*	Capacity	Total	1.064	*Sîn-rāmā*
LB 1069	1 × 60 + 25	1 × 60 + 2**3**	2	System S	Total	2.41	Scribe M

carried out, that is to say, that the quantity shipped, or the capital, was compared with the amounts delivered and disbursed. Both texts also result in decreased granularity, which is not reflected in the totals delivered and disbursed. Indeed, both texts decrease granularity to *ban*.

YBC 05494 is a grain delivery text and has already been mentioned in connection with the grain storage bureau (see Chap. 7). Added values in this text produce *sila* as the lowest measure in the total of the expenditure section. Value in the difference is rounded up 4 *sila*. The difference is 0.11 per cent between the expected value and the stated value. LB 1072 is the product of an unnamed author writing for a household administration, perhaps near the newly conquered city of Isin in *Rīm-Sîn*'s thirty-first year. The author recapitulates quantities of grain expended from a capital amount over several days. Value is rounded up 1/2 *sila* to produce 3 *ban*. The difference here is 1.7 per cent. While a difference of 1.7 per cent may seem large compared to the 0.11 per cent difference of YBC 05494, measured and remeasured grain values in YBC 05494 varied by 2.07 per cent. After rounding is considered, this difference appeared as 2.076 per cent. When measurement inconsistency was considered, difference was greater with the example of YBC 05494 than with the example of LB 1072. As stated in Chap. 7, truncation at a higher value produced greater certainty of measured values. By rounding up, the scribes increased the stated difference and thus the certainty of error in this calculated difference or remainder. Both texts, thus, round up to *ban* and, while they may increase the appearance of error, this increased error also gives the appearance of confidence in a second measured or stated value.

In the case of Ashm 1923-340, rounding up provided evidence for the counting device proposed for YBC 04224, NBC 06763 and LB 1075 above. A counting device would have exploited natural splits in the metrological system to divide up calculation in order to fit onto the device. Scribes divided measured or calculated values into higher or lower parts, added these parts up and then rounded each of the individual parts, which were then appended together to produce totals. In Ashm 1923-340, the scribe rounded 5 *ban* up to 1 *bariga* in order to simplify the lower value, which in turn simplified addition of lower and upper values. Yet he still kept 1 *bariga* as a lower value, rather than append it to the upper value, showing that he did understand these as two separate numbers appended together.

LB 1069 probably dates to *Rīm-Sîn* of Larsa's thirty-eighth year, belongs to the grain harvest archive and is attributed to scribe M. In this text, a quantity of men, $1 \times 60 + 23$ is rounded up by 2 to produce $1 \times 60 + 25$ in the total. AO 08524 belongs to the *Sîn-rāmā* archive and is dated to *Rīm-Sîn* of Larsa's fiftieth year. One *sila* is added to the total to round 1 *bariga* 3 *ban* 4 *sila* up to 1 *bariga* 3 *ban* 5 *sila*. Both of these roundings produced rather sizable differences, 1.064 per cent in AO 08524 and 2.41 per cent in LB 1069. With both texts, addition is relatively simple; only three values are added together in LB 1069 while only two values are added in AO 08524. Thus, it seems unlikely that a mistake was made in addition, nor that a calculation device was used. In AO 08524, the rounded value appears again in line 11, further suggesting intent. Just like with NBC 05474 presented above, these rounded values seem to be more out of preference than anything else: the scribes

simply preferred to work in increments of five. This would imply conformity based on measurement values and perhaps an intended further computation. Perhaps these would be added values in a further summary account. Unfortunately, this is difficult to prove due to a lack of evidence for each individual.

Rounding up could lead to an increase in certainty of error and then, through this, produce more confidence in measured differences or remainders. This is suggested by YBC 05494 and LB 1072, where rounding up the remainder decreased granularity. In the case of Ashm 1923-340, LB 1069 and AO 08524, rounding was performed out of a desire for simplification, perhaps out of a simple preference for certain values, or perhaps in preparation of a future addition or subtraction as well. Indeed, Ashm 1923-340 rounded up to simplify appending values together after using an abacus.

9.4 Rounding and Multiplication

In two texts, rounding occurred in the process of, or as a result of, a multiplication. These are summarized in Table 9.7. Two values found on NBC 08014 and YBC 07473 result from a multiplication or division by means of multiplication by a number's reciprocal and result in negligible differences of less than one per cent. With NBC 08014, value was probably rounded up 1 in SPVN to simplify transformation between SPVN and measurement values. Rounding up 3:39, which transformed to 3 1/2 *gin* 27 *še*, to 3:40, the SPVN transformation of 3 2/3 *gin*, reduced the number of parts transformed from three (3, 30 and 9) to two (3, 40). Rounding 36:40, which transformed to 1/2 *mana* 6 2/3 *gin*, down to 36:30, which transformed to 1/2 *mana* 6 1/2 *gin*, did not simplify transformation at all—both were transformed in three parts. However, rounding to 3 2/3 *gin* produced a similar decrease in granularity, as seen above: the lowest measurement value is a fraction of *gin* rather than an amount of *še*. Thus, in this example, transformation is simplified when measurement value is simplified.

YBC 07473 rounded up after calculation. A mistaken understanding of the relationship between 11 and its approximate reciprocal decided the direction of

Table 9.7 Rounding in, or as a result of, multiplication

I. Text	II. Stated value	III. Expected value	IV. Rounded value	V. System	VI. Placement	VII. Per cent difference	VIII. Scribe
NBC 08014	3 2/3 *gin*	3 1/2 *gin* **27 še**	3 *še*	Weight	In-kind value	0.457	*Ilšu-ibbišu*
YBC 07473	5 1/3 *mana* 7 one-4th *gin* 5 *še*	Uncertain	NA	Weight	In-silver value	Less than 1	*Itti-Sîn-milki*

rounding. The author, *Itti-Sîn-milki*, probably believed that a multiplication by this number's reciprocal would produce a deficit rather than an excess. In addition, rounding was influenced by how measurement values were organized in metrological tables, as well as their relationships to SPVN numbers as stated in these tables. Thus, the author rounded the SPVN number up from 5:27:16:22, which transforms to 5 1/3 *mana* 7 one-4th *gin* 4 *še* and a little above one-12th *še*, up to 5:27:16:40, which transforms to 5 1/3 *mana* 7 one-4th *gin* 5 *še*, even though rounding down would be expected if he rounded to offset roundoff error. He probably rounded up to 5 *še* rather than to 4 1/2 *še* because 1/2 *še* belonged to a different cycle of SPVN numbers. 5 *še* and 4 *še* were part of the same SPVN cycle. As seen in Chap. 7, values below those present on the metrological tables were difficult to work with at best for these ancient scribes. The author of YBC 07473, *Itti-Sîn-milki*, was working with a difficult value and probably decided to avoid this fraction altogether by rounding between measurement values that corresponded to a different SPVN cycle than that associated with one-12th *še*. This was a decrease in granularity as well, one based on SPVN cycle shifts. With both NBC 08014 and YBC 07473, numerical and metrological tables probably played an important role in the construction of numbers and value. Both texts also decrease granularity.

9.5 Rate Approximations and the Uncertainty of Interpretation

Rates were important in estimating value, whether revenue, equivalency, labor or any procedure that relied on algorithms that built on these—the economization of mathematical practice described in Chap. 8. Indeed, both calculations in Table 9.7 required the use of a rate, as did the truncated value in LB 1075 discussed in Table 9.2. However, some rates themselves seem to be rounded values. As just summed up, the rate of lines 13 to 14 of YBC 07473 required an approximate reciprocal in order to carry out the calculation because the rate involved, 1 *bariga* 5 *ban* per *gin* silver, transformed into a non-regular SPVN number, 1:50, and thus defied easy division. In addition, AO 08461, an accounting of grain rations dated to *Rīm-Sîn*'s fifty-seventh or fifty-eighth year and authored by an unknown scribe, states an approximation of the rate he used to calculate wages. 2 *ban* 7 *sila* per day is rounded up to 3 *ban* per day. By rounding this rate up, writing is simplified, and space taken by the rate is significantly reduced. It was easier to round up to and write 3 *ban* than to write 2 *ban* 7 *sila*. Thus, it is safe to suggest that this rate was rounded up for simplicity's sake. YBC 07473 shows that unstated approximations can occur during a calculation with a rate, while AO 08461 shows that a rate does not always state the number used to carry out a calculation, only an approximation of that number.

YBC 07473 and AO 08461 are not the only examples of approximate rates. LB 2053, attributed to an unnamed scribe working around *Rīm-Sîn*'s thirty-fourth year,

simply states approximate rates in producing bran out of grain for set periods of days, while LB 1097, of unknown provenance, authorship or date provides approximate rates for grain used in preparing a field. For the former, an initial grain value is not provided, while for the latter the size of the field being prepared is not stated, so that the size of the discrepancy cannot be projected. Instead, it is only possible to state there is a discrepancy and very tentatively suggest how this may have been produced. It is not possible to state with any certainty how the calculation was carried out. The discrepancy could be quite substantial, as the rate in AO 08461 makes clear. Table 9.8 attempts to show the uncertainty in interpretation using LB 1097 as an example.

Table 9.8 Computed field size and expected field sizes for LB 1097

Possible field size in LB 1097 based on rate calculation:
Rate transformations:
Line 3:
3 *iku* → *5* (table of area/volume)
1 *bariga* → *1* (table of capacity)
Line 5:
1 *bur* → *30* (table of area/volume)
7 (*bariga*$^{?}$) → *7* (table of capacity)
1 *bariga* → *1* (table of capacity)
7 + *1* = *8*
Line 7:
1 *bur* → *30* (table of area/volume)
1 *gur* 1 *bariga* 4 *ban* → *6.40* (table of capacity)
Line 12:
3 *iku* → *5* (table of area/volume)
1 *bariga* → *1* (table of capacity)
Line 14:
1 *iku* → *1:40* (table of area/volume)
1 *bariga* → 1 (table of capacity)
The area statement multiplied by the grain statement's reciprocal produces the grain/area rate. Note that 1 did not require a reciprocal extraction, so that only multiplication was necessary for calculation:
Line 3:
5 × *1* = 5
Line 5:
the reciprocal of *8* is 7:30
30 × 7:30 = 3:45
Line 7:
the reciprocal of *6:40* is 9
30 × 9 = 4:30
Line 12:
5 × *1* = 5
Lines 13–14
1:40 × *1* = 1:40
Grain to land evaluation:
4 *gur* 2 *bariga* 2 *ban* → *22:20* (table of capacity)

(continued)

Table 9.8 (continued)

5 *gur* 1 *bariga* 1 *ban* 5 *sila* → *26:15* (table of capacity)
4 *gur* 1 *bariga* 5 *ban* 2 1/2 *sila* → 21:52:30 (table of capacity)
4 *gur* 2 *bariga* 2 *ban* → *22:20* (table of capacity)
4 *bariga* → *4* (table of capacity)
4 *iku* → *6:40* (table of area/volume)
In-grain value multiplied by the grain/area rate produces the total area:
Line 1–3: *22:20* × 5 = 1:51:40
Lines 4–5: *26:15* × 3:45 = 1:38:26:15
Lines 6–7: *21:52:30* × 3:45 = 1:38:26:15
Lines 8–12: *22:20* × 5 = 1:51:40
Lines 13–14: *4* × 1:40 = *6:40*
1:51:40 → 3 *bur* 2 *eše* 1 *iku* (table of area/volume)
1:38:26:15 → 3 *bur* 5 *iku* 6 *sar* 15 *gin* (table of area/volume)
Upper limit for field size: 3 *bur* 2 *eše* 1 *iku*
Lower limit for field size: 3 *bur* 5 *iku* 6 *sar* 15 *gin*
Field size based on added values:

Line	Notes	Quantity area			
8		1 *bur*	2 *eše*	1 *iku*	
9				3 *iku*	1 *ubu*
10		1 *bur*		4 *iku*	1 *ubu*
	Subtotal	3 *bur*		3 *iku*	
13				4 *iku*	
	Total	3 *bur*	1 *eše*	1 *iku*	

LB 1097 lines 8 through 13 state various fields, which, when added together, produce a total field size of 3 *bur* 1 *eše* 1 *iku*. Rates, after a suggested computation (for which there is no corroboration of this suggested calculation in the mathematical tradition), produce two values: 3 *bur* 2 *eše* 1 *iku* and 3 *bur* 5 *iku* 6 *sar* 15 *gin*. However, the total added area is not stated, and it is clear the 4 *iku* field of line 13 was treated differently from the other fields. Thus, the exact field size is uncertain, so that it is not certain how approximation was carried out, only that an approximation took place. As noted in Chap. 5, not all information was provided in every text because they were produced in specific professional contexts in which some information may have been assumed. LB 1097 lacks a date, which suggests that calculations were produced in pursuit of a project statement, similar to those produced in the bureau of irrigation and excavation and similar to those suggested for the grain production archive and grain harvest archive. This text was, then, produced for planning purposes and would become obsolete when fields were prepared. Thus, an information key for interpreting this text is missing, such as the total size of the field prepared or the exact rates used to calculate grain costs in cultivation. Much mathematical knowledge used to produce these calculations is not expressed in the extant mathematical tradition so that we cannot posit with any certainty how calculation would have been carried out. Lack of tacit knowledge affects our interpretation of error.

9.6 Conclusions

In order to fully understand rounding, mistake and error must be explored again. A distinction was drawn at the beginning of this volume, following Hon (1995), between a mistake, an avoidable case of ignorance in which the actor unintentionally deviates from a truth, and an error, where the actor enters into the unknown with a proposition of a true value that is proven wrong. To Hon, however, a mistake was a deviation from a rule, while an error was an error because there was no set of agreed-upon practices to guide an actor into the unknown (*ibid.*: 9). A further distinction was produced by Asper (2012), who saw some errors as 'false'. These errors were socially established as acceptable—either there was intent behind them, or there was no reasonable criticism of their production. The present volume has explored the intentionality of error, arguing that some errors were intentional or at least that the scribe was aware of potential deviations between his assertion and a truth. It was asked whether, in an administrative environment, some errors could be based on a set of customs or practices in order to maintain acceptable deviations from a truth. Finally, how did rounding fit in?

To begin with, there were possibly three varieties of errors in the text. First, observational errors are understood here as those which appear with the measurements themselves, following Allchin's distinction of discrepancies (Allchin 2001: 6). These discrepancies occurred in initial data collection, that is, the way in which data was observed and then exploited in the texts themselves. This is an important distinction: the texts themselves record observations of both instrument and performance. As seen in Chap. 7, variance existed in weights and measures, while the measurement techniques employed by the scribes to assess value produced discrepancies. The texts themselves recorded observations of both. The term measurement inconsistency was coined to describe the potential variance between a stated measurement, often referring to a previous measurement, and a second measurement. The scribes, the observers in these instances, are clearly aware that this error existed and, as seen with grain shipment texts, limited visible errors by truncating stated value.

Conceptual errors are understood here as errors resulting from theories or conceptions of reality that are used to evaluate a current or future situation (following Allchin 2001: 8). Chapter 8 explored conceptual errors in the form of estimation and conformity. Revenue assessments, equivalency calculations, as well as labor and wage calculations, all based on a form of rate, could be understood as estimations. Each presented a conception of reality used to evaluate a current or future situation.

In each case, error becomes apparent with measurement: because observational errors were recognized to exist, uncertainty in measurement led to uncertainty in each estimation. However, the scribes seemed aware of this and developed practices to limit potential discrepancies and culpability.

Systematic errors, errors inherent in the numerical system or calculation system, were proposed to exist as well. These are visible in exercises with the reciprocals of

non-regular numbers like 7 in texts like M 10. The appearance in YBC 07473, an economic text, of a discrepancy resulting from such an error shows that this awareness was not limited to an academic setting but existed in economic practice as well.

With all three varieties of error, the scribe was aware of deviation from expected values or numbers. Moreover, with all three varieties of error, certain practices were developed to cope with these errors. Measurement inconsistency resulted from accepted measurement practices. Estimation was the result of procedures taught in a scholastic setting. Finally, exercises with non-regular numbers show a tendency toward the production of practices for calculation with the reciprocals of non-regular numbers. Error is the result of a scribe's entry into the world of terra incognita, as Hon put it, but in the realm of economics, practices existed to assist in navigating this world. Thus, in an economic setting, a distinction between mistake and error was one of awareness. And so now we can explain how rounding fit in with the errors just outlined.

Rounding is understood here as an intentional deviation from an expected measurement value, numerical value or result of a calculation. With rounding, the expected value is replaced by another value that is near to this expected value but is shorter, simpler or presents a more concise statement than the expected value. A rounded value can, and often does, occur with other deviations from the expected value, whether mistakes or other errors. At least one example of rounding can be associated with each variety of error outlined above, as well as mistakes.

As noted above, mistakes can occur anywhere in a calculation or text because a mistake is an unintended deviation from an expected or true value, the result of an actor's inattentiveness to societal rules of calculation. LB 3051, line 6 exhibits both a mistake and a rounded value. The mistake shows 2 *ban* mistakenly added to the subtotal, while the rounding shows 5 *gin* removed from the total, which results in coarser granularity. Why does rounding occur in this text? To answer, similar examples of rounding must be sought.

LB 3051 rounds by means of truncating the final measurement unit, *gin*, off the total so that granularity is limited to *sila*. Rounding down by truncation occurs in several instances. Truncation was especially evident in the grain shipment texts, where, as pointed out in Chap. 7, coarser granularity in measurement values resulted in less apparent variability between measurements before and after shipment. To put it simply, as exactness decreases, so does apparent inconsistency between measurement values. Thus, granularity in texts was probably a preference of scribes so that measurements limited to higher measurement units, units with coarser granularity, may have an unstated rounding by means of truncation. In this scenario the author of a text would simply decrease granularity without explicitly noting this decrease in the text in an effort to increase confidence in a measurement value. This is underlined by LB 1075, where the author probably calculated an approximate remeasurement using a sample measurement and change rate. In this text, granularity was a choice: the scribe chose to state whole *sila* even when he could have stated fractions of *sila*. This was probably because the scribe used a

counting device, such as an abacus, while this choice was made acceptable by an awareness of measurement inconsistency.

Twelve examples of rounding by truncation occurred in eleven texts and across systems. Each example of this kind of rounding decreased granularity by removing the lowest component(s) of measurement values from the result of a calculation. These values decreased granularity and thus produced an apparent reduction in measurement inconsistency. Indeed, it could be said that rounding in general, whether up, down or by truncation, had the effect of increasing certainty or confidence in a measurement value. This is because the authors who produced rounded values were aware of the possible variance of capacity measurement values, weights and even volume measurement values—one can surmise that authors were aware of possible variance for all measurement values and systems. Indeed, with capacity at the least, initial measurements were always greater than remeasurements. Difference produces a negative discrepancy in value. Thus, with grain especially, rounding down to decrease granularity makes much sense. Rounding up of remainders and differences is acceptable as well, because these are stated variances so that an image of confidence in the second measured value is produced.

In most cases, perceivable difference in truncated values was low. Explicit rounding tended to produce negligible discrepancies, typically below one per cent with very few exceptions, and only exceeded 2.5 per cent in one instance, a labor rate that can be considered more of an abstract guideline to calculation than a firm statement of assessment. These percentages are important. As suggested in Chap. 7, the scribes probably had a concept of margins of error: the scribes tended to limit granularity to greater coarseness when this produced a marginal error. This change was possibly imperceptible in most instances, so that increasing confidence in a stated value would not have produced a measurable difference, only a calculated one.

Rounding was a tool used to reduce uncertainty in measured and added values. However, in YBC 07473 lines 13 to 14, rounding could have been used to reduce potential error in multiplied values. With this equivalency rate, it was suggested that the author used an approximate reciprocal for the stated rate of 1 *bariga* 5 *ban* per (*gin* silver), which transforms to SPVN 1:50, a non-regular number. The author probably rounded up the equivalent value in silver to offset error in the calculated values in which an approximation was used. The author of this text was attempting to increase confidence in his calculated value because he was aware of the error inherent in his computation of equivalent value.

However, with YBC 07473, rounding also points to a mistake. The author of YBC 07473, *Itti-Sîn-milki*, misunderstood the relationship of the approximate reciprocal to its non-regular number and thus rounded in the wrong direction. While the author of YBC 07473 was aware of uncertainty when working with approximate values, he could still make a mistake. This points to the difference between error and mistake: a mistake is avoidable, but the author is unaware of its existence and does nothing to mitigate it. An error is unavoidable or potentially unavoidable, but the author is aware of its potential and can act to mitigate it. However, discrepancy associated with both mistake and error only become clear upon

observation, so that *Itti-Sîn-milki* could neither know how much of a discrepancy using an approximate reciprocal he would produce upon measurement when measurement inconsistency was taken into account, nor that he had produced a mistake.

Rounding was a tool used to increase confidence in measured values and calculated values in which the scribes were aware of potential observational, conceptual and systematic errors. The purpose of rounding was to mitigate error because, as Hon points out when discussing experimental error, the author was working in the unknown. The authors were aware of uncertainty and consequently used rounding as a means of marginalizing uncertainty, just as *Itti-Sîn-milki* probably attempted in YBC 07473.

However, this tool was still limited by the uncertainty related to the practice of estimation: there was an error associated with it and this error could not be known. While truncating a value to offset measurement inconsistency, the scribe was still uncertain of what the discrepancy would be. Indeed, the scribe did not know how much was truncated off a measured value if, for instance, measurement was limited to *bariga* but could be measured to *sila* and even *gin* or *še* measurement values. It cannot be known how much is missing from a truncated value. Thus, the tool itself produces an error just like any measured or calculated value, even if it attempts to limit discrepancy. This may be why acceptable rounded values were low, typically limited to around differences of 2.5 per cent and often to differences of less than one per cent. Five to six per cent differences were only accepted in a very few instances. The tool itself could cause error; the scribe could not know whether by following customs or established practices associated with rounding, he was reducing discrepancy or increasing discrepancy. This is especially clear with error and mistake in YBC 07473: the author followed an accepted practice associated with rounding, but a lapse in understanding this practice produced greater discrepancy. This was then compounded by a further practice associated with how to round in order to offset error. The author of YBC 07473 did, indeed, roam around in the dark, as did the scribes in the grain storage bureau. They were obliged to, however, if they were to run a complex economy, and so the tool rounding was based on customs and practices that limited culpability. The success of these customs and practices is also shown in YBC 07473: because rounding is limited to negligible differences to begin with, even with a mistake the discrepancy is marginal, less than one per cent.

Chapter 10
Conclusion: On Errors, Rounding and Education in the Kingdom of Larsa

Abstract The conclusion provides a final assessment of rounding numbers and of what the practice of rounding numbers can tell us about scribal education. The systematic use of rounding suggests that it was an important feature of record keeping, one with customs and practices associated with it, that existed to help navigate the uncertain realm of error, to simplify calculations, to mitigate possible discrepancies between expected and actual values and, perhaps, to cross between cultural and microcultural boundaries. Rounding helps to show the existence of a universal elementary scribal education as well as advanced educations that probably took place in professional environments. Moreover, rounding helps to show what these educations consisted of. Rounding exploited the makeup and organization of metrological lists and tables as well as numerical tables. Rounding helps to illustrate the importance of commentary in the advanced education of scribes. It helps to highlight algorithms used to construct value, as well as tools used to construct texts. In short, rounding numbers can be used as a tool to help us, the modern readers, understand numeracy in the ancient world.

While rounding may have been an ancient tool, it can help us to understand how calculation was carried out and the educations of scribes themselves. First, in the case of the grain storage bureau, which was composed of merchants and other professions, truncation of measured values to reduce measurement inconsistency helps us to realize that measurements were performed in and around the city of Larsa itself. This may seem obvious, but measurement is seldom stated in the texts so that even this simple act needs to be proven. This is clear from the discussion in Chap. 5, where it was shown that some apparent measurement values were probably the results of an estimation by the scribe and not observation of measurement or measurement instruments. Indeed, in Chap. 7 it was seen that some assessments of value were based on a sample measurement followed by a change rate calculation. Estimation presents a potential observation, not an actual observation.

In YBC 07473, rounding was based on measurement values as they appeared on metrological tables and their SPVN transformations. The author of YBC 07473, *Itti-Sîn-milki*, the merchant overseer of *Zarbilum*, probably rounded 4 one-12th *še*

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up to 5 *še* and not 4 1/2 *še* because to round one-12th *še* to 1/2 *še* would have added a value outside of the SPVN cycle in which the author was working. Thus, rounding up to 5 *še* made more sense. Moreover, the author of YBC 07473 probably rounded this value because one-12th *še* is not found on any extant metrological list or table. While a scribe could work with values outside of these lists, to do so was often difficult, so that rounding in either direction was preferred.

To the modern observer, rounding reveals practices associated with calculated approximation, and this can help us to understand how a scribe was educated. This is seen with YBC 07473 as well. The importance of metrological tables, which the scribe learned in his elementary education, becomes apparent with this rounding: *Itti-Sîn-milki* was familiar with numerical tables learned in the elementary stage of the scribal curriculum because he carried out a series of divisions by means of multiplications with reciprocals. Most of these reciprocals are found in the standard reciprocal table. However, 1:50, the SPVN transformation of 1 *bariga* 5 *ban*, is not. It is a non-regular number of which the factors are 11 and 10. He was probably familiar with non-regular reciprocals and, if he rounded up to reduce roundoff error, he probably trained with texts similar to M 10. Because he was working with equivalencies, this merchant probably participated in an advanced, perhaps professional education of some form which involved equivalency calculations as described in Chap. 8. This latter is confirmed with AO 08464, presented in Chap. 5, which was used to show conformity of equivalency rates.

The city of Larsa and its surroundings, including *Zarbilum*, where *Itti-Sîn-milki* was active, is well represented in the texts. The education of *Itti-Sîn-milki*, which is witnessed in the texts that bear his name, provides an image of education in just one of the towns and small cities that made up the hinterland of the city of Larsa. The texts produced by *Itti-Sîn-milki*, and the discrepancies associated with these texts, explain some aspects of a high-ranking merchant's education in Larsa's hinterland. A fairly complete picture of the education of a merchant at and around Larsa can be produced because many of the texts attributed to Larsa or the Larsa area were produced by merchants. Indeed, it is clear that *Itti-Sîn-milki*'s education, including the use of the reciprocals of non-regular numbers, must have been somewhat standard. The equivalency rate of 1 *bariga* 5 *ban* was stated as 'kar' or 'fixed rate'. This kind of rate was probably fixed by the local merchant community so that within the city of *Zarbilum*, which was probably reflective of Larsa's education system due to its proximity to Larsa, the ability to work with the reciprocal of a non-regular number would have been assumed by this community. That is to say, if prices were fixed by this community then they must have agreed upon the rate 1 *bariga* 5 *ban* so that members of this community would be familiar with non-regular numbers and their approximate reciprocals.

SPVN was probably used while calculating this equivalency with YBC 07473, as stated above. Chapter 5 showed that the use of SPVN was probably fairly standard when computing with equivalency rates, as well as wage rates, throughout the kingdom of Larsa. This was corroborated by NBC 08014, probably from Larsa as well, where a bureau official probably rounded an equivalency to simplify

transformation between SPVN and measurement values. Thus, equivalencies were not limited to a merchant's education.

Equivalencies, as a form of estimation, rely on multiplication to carry out a calculation. The numbers and values used to calculate probably came from two sources: other texts or prior operations, as well as direct observations of the tools or performance of a measurement. YBC 04224 speaks to the derivation of multiplied values from prior operations. This text is a merchant account potentially dated to the reign of *Gungunum* of Larsa and with a suggested provenance of around Larsa. Lines 15 through 25 state various sesame expenditures for which the total found on line 26 is rounded down. This total serves as the basis for an equivalency evaluation in silver. The stated equivalency was probably the result of an actual calculation by the scribe who produced this text because the rounded sesame value was used to produce the equivalency, not the expected sesame value. The scribe added measurement values together, rounded and then made the equivalency.

The scribe rounded down in YBC 04224 to simplify calculation. This is also one possible reason for the subtotal and possibly also the total in NBC 06763 from Larsa as well. The subtotal and total did not reflect the volumes stated in the texts, which are based on observations of man-days. Instead, they probably reflect prior calculations of volume from length by width by depth. If true, then lines 12 through 13 round down to produce 4 *iku* 26 *sar* 10 *gin* volume by means of truncation of added values during addition. This would mean that the subtotal and total allow comparison of a projected cost with an actual cost in man-days of labor, and thus reflect an additional calculation. The same can be said about the text's total in line 15, where the rounded value in lines 12 through 13 is carried over to produce 4 *iku* 41 1/3 *sar* volume rather than 4 *iku* 41 *sar* 11 2/3 *gin* as expected.

By limiting the final numerical value associated with the lowest measurement unit to 1/3, the author simplifies multiplication: only a table for 20, the SPVN transformation of 1/3 *sar*, is needed to multiply the final digits in SPVN rather than the slightly more complex need to multiply using a table of 10 and table of 1:40 that was required prior to rounding (because 11:40 is the SPVN transformation of 11 2/3 *gin*). Conformity in YBC 04224 and NBC 06763 leads to simplification of calculation. This value would have been used to calculate labor and then wages following discussion in Chap. 8, especially problem 1 of YBC 04663.

Volume measurement values like those used to produce the subtotal and total on NBC 06763 would have been used to evaluate labor and then wages as is shown explicitly with YBC 12273, and as is suggested for NBC 11509 and its associated wage rate texts. Indeed, YBC 12273 shows that volume, and then probably labor, was calculated using SPVN just as is proposed for NBC 06763 when rounding may have simplified calculation in SPVN. Thus, the subtotal and then total reflect a further computation, labor and wages, so that the added value could well have been rounded to facilitate this, as well as to simplify calculation with a counting device and reduce perceived measurement inconsistency.

Some observation must have been the basis for all calculations. An observation, whether this was of a full measurement of a quantity or a sample measurement, would have been the input in any initial calculation, whether an addition,

subtraction or multiplication. The measurement values of in-kind items which are evaluated in grain or silver must have been measured. Evidence that measurements were actually carried out and observed by scribes in and around Larsa is provided by the grain storage bureau. As stated in Chap. 4, this bureau was probably staffed by merchants, among other professionals. Discrepancies between measurement values taken before shipment and after delivery show that the scribes were aware of measurement inconsistency in so far as capacity was concerned. The degrees of granularity in each text show that they marginalized measurement inconsistency by truncating measured values. This was hypothesized as having been taught in the early elementary phase of scribal education when tabular lists were learned in school. At that phase, the education of merchants and other professions probably involved the memorization of metrological lists, which would have been a perfect time to explore measurement practice and inconsistency. Thus, the economic documents show that metrological lists and tables, as well as numerical tables, were probably incorporated into the education of scribes around Larsa. A similar phenomenon probably occurred in the territory of Isin after *Rīm-Sîn*'s conquest, based on the appearance of a value rounded up to decrease granularity in the difference of a balanced account.

One grain shipment text also shows that sample measurement to convert value between standards was used in this bureau. In YBC 07194 line 8, the phrase '9(aš) 2(bariga) gur *ru-ub-bu-u*$_2$ *ša* ^{giš}ba-ri$_2$-ga', '9 *gur* 2 *bariga* the increase of the *bariga*-standard vessel' appears. It was proposed that this text referred to the sample measurement of grain and then multiplication by a change rate to produce the difference between the old standard and the new standard. Sample measurement underlines the importance of metrological lists and tables, while the change rate calculation suggests the importance of numerical tables in assessing approximate value out of measured value.

In the grain shipment texts, values were added and subtracted as well. Rounding can offer some insight into this process. Ashm 1923-340, a tabular account from the grain production archive possibly from Larsa, even though it reports activity around Ur, presents addition of both grain and area carried out by bureau officials during the reign of *Hammu-rābi*. This text, discussed in Chap. 6, shows partitioning of measurement values into upper and lower levels. This is suggested by their appearance over two lines. The partitioning of numbers into upper and lower levels is probably due to an instrument such as an abacus being used to facilitate calculation. The scribe in question added each level up separately and then appended lower level calculation to upper level calculations. Thus, by rounding 5 *ban* up to 1 *bariga*, the author simplified the statement in the lower level, which in turn made it easier to append lower and upper levels together. The author of this text still divided lower and upper values between lines, even if all values would fit on one line, which shows that he did understand these as two separate numbers appended together.

Rounding helps to illustrate that these partitions were based on natural splits within the capacity system in Ashm 1923-340, and this was supported by a similar division in Ashm 1922-277, as well as mistakes in carrying numbers between

columns in YBC 04224. Granularity was limited to *sila* measurement units in Ashm 1923-340 and *sar* measurement units in Ashm 1922-277, while a split was shown at *mana* in YBC 04224. The scribes who produced Ashm 1923-340 and Ashm 1922-277 preferred to work with values found on the capacity and area metrological lists, rather than with *gin* and *še* measurement values which were present on the metrological list of weight but used to subdivide capacity and area as well. The scribe who produced YBC 04224 exhibited different mistakes at and above fractions of *mana* and at and below *gin*, suggesting that *gin* measurement values and below were treated differently from *mana* measurement values. All this helps to confirm that, at Larsa, metrological lists and probably tables of capacity started at fractions of *sila* measurement units rather than *gin*, as at Nippur. Perhaps the lists of area at Larsa commenced at fractions of *sar* measurement units, as expected.

Rounding numbers shows practices limited to individual archives as well. NBC 05474 and NBC 06339 describe brick disbursements to various foremen as part of a canal construction project, while NBC 09050 describes the production of bricks during this canal's construction. Because these texts are part of the *Lu-igisa* archive, which belongs to the bureau of irrigation and excavation, brick production, disbursement and then construction probably fell within the parameters of this professional setting. This suggests a professional environment which involved both brick deliveries and earth transport in the bureau of irrigation and excavation. Rounding in this archive suggests standard values were used. With NBC 05474, 47 5/6 *sar* seemed to be rounded down to 47 2/3 *sar*. The author perhaps preferred to work in halves and thirds of *sar* rather than sixths of *sar*. Thus, rounding here was based on archival preference.

Rounding also helps to show the utility of coefficients. The use of coefficients in calculation suggests conformity as well. This was especially clear for the bureau of irrigation and excavation. There, standard labor rates exhibited in mathematical texts were exploited to assess labor in YBC 12273, although it is equally clear that labor rates used in YBC 12273 differed slightly from the mathematical text in how they were defined. Standard wage rates appeared in Riftin 1937: no. 114 and 116 to help assess project costs. NBC 06763 and Ashm 1922-290 seemed to use standard rates in assessing volume from observed man-days. Both texts seemingly used rounding as a means to offset uncertainty associated with estimated volume measurement values, as witnessed in YBC 12273.

Similarity was seen between interest revenue suggested in A.26371, tax revenue in AO 08493, change rate calculation in LB 1075 and conversion calculation in YBC 04265. Interest was presented in mathematical texts like VAT 08521. However, calculation with tax, change and conversion rates are not visible in any scribal curriculum. The same can be said of labor calculation and yield calculation —while labor is present in mathematical texts, it is never associated with yields in these texts. This suggests an economization of mathematical practice in which one algorithm that was associated with one situation was implemented in other, similar situations. While mathematical texts present, for instance, interest calculations, it can be hypothesized that a form of commentary accompanied the presentation of an algorithm, explaining the processes involved in carrying out interest calculations

and then the applicability of this algorithm and its components as well as differences in setup and results. The table as a medium for practice assisted the teacher in expressing this economization of practice. Thus, a teacher presenting interest rates could follow this with a discussion of other value assessment methods like change rates, conversion rates and tax rates. This could easily account for much of the missing evidence of scribal education.

The algorithm presented with VAT 08521 is useful across milieu. A.26371 is attributed to *Šēp-Sîn*, the merchant overseer of Larsa, AO 08493 was probably produced by a conveyor working for *Sîn-rāmā*, LB 1075 is attributed to the archive of a notable named *Sîn-iddinam*, while YBC 04265 is attributed to *Nabi-Šamaš* B. Conformity is produced by the very algorithms presented to student scribes, while at the same time conformity is exhibited by the numbers and measurement values used in economic texts, betraying the importance of the various metrological and numerical lists and tables that were learned in the elementary scribal education. This suggests the universality of education in the kingdom of Larsa and begs the question as to how universal these educations were.

The portrait of education provided by rounding numbers, when combined with other errors and mistakes, is one of a single, uniform metrological and numerical system manifested in numerous microcultures within the kingdom of Larsa. A somewhat uniform elementary mathematical education, whether classroom or professional, appears or is alluded to throughout the kingdom of Larsa. This education consisted of at least familiarity with metrological lists, but more likely incorporated the memorization of metrological lists and tables as well as numerical tables. Familiarity with metrological lists and tables is suggested by the awareness of measurement inconsistency seen in the grain storage bureau, as well as the appearance of truncated values along natural splits in measurement systems. Indeed, these truncated values, as well as other rounding based on natural splits, showed training with tools such as an abacus probably occurred during this relatively universal elementary stage when metrological lists and tables were memorized. An abacus would also speak for the use of partial-SPVN. Familiarity with metrological and numerical tables was suggested with YBC 07473 and NBC 08014 to produce equivalencies, and especially YBC 12273 to calculate volume. Some training with non-regular numbers late in the elementary education or in an early advanced education was suggested with YBC 07473. This is the image of elementary education produced from Larsa and its hinterland, including the city of *Zarbilum*.

The elementary education is evident across different milieus, in household, bureau and merchant environments. Outside of Larsa, evidence is much sparser. At Isin, scribes were at least familiar with metrological lists for capacity and measurement inconsistency associated with measurement values presented on these lists. For Ur, it can be difficult to tell what education was common because much of Ur's administration was conducted by merchants and bureaucrats from Larsa, such as the notable *Gimillum*, as described in Appendix 2.G. This points to the possibility that both Ur and Larsa may have had similar educational processes. This would be because much temple estate administration was eventually moved to Larsa, so that officials and merchants from Ur would have been active in Larsa even

while officials and merchants of Larsa would have been involved in administering Ur.

However, as was seen in Chap. 2, while numerical and metrological systems may have been based on a uniform mathematical culture, both metrological and numerical lists and tables differed between, and even within centers. Occasionally glimpses are offered into the format of these lists, such as at Larsa where the standard metrological list for capacity could very well have commenced with *sila* measurement units, rather than *gin* as at Nippur. The potential significance of these microcultures is witnessed in Chap. 7 where the ability of both student and master to deviate from these lists was observed. Metrological lists and tables formed the building blocks of measurement, as shown by measurement inconsistency in the grain storage bureau. Both metrological lists and tables as well as numerical tables formed the building blocks of calculation as seen in Chap. 5, and with NBC 08014 and YBC 07473 especially in Chap. 8. In Chap. 7, differences in standards also suggested different cultures and nuanced microcultures as well as the ability to cross between these cultures, both in measuring standards and estimating standards. The different cultures and microcultures affected how scribes evaluated both measured and calculated data, indicating that cultural and microcultural differences must have had an effect on economic activity.

Advanced education was less universal. The texts presented here show two possible forms of advanced education: an education which made use of mathematical texts evidenced in a school setting, and then a professional education that built on an elementary and perhaps even early advanced education in a school setting. Mathematical coursework probably centered around different algorithms and components of these algorithms that could be applied in multiple settings. This was quite visible when examining value assessments as seen in and around Larsa. Interest rates are well attested in the texts, while tax, change and conversion rates are not attested at all. The same can be said of labor rates with excavations and harvest. We might even speak of classes of algorithms as understood by the ancient scribes; in the cases presented here these would be rate and labor class algorithms based on the tables described in Sect. 8.4.

However, as noted in Chap. 8, commentary did not necessarily have to take place within a school setting. A student and teacher needed only to be familiar with an algorithm in order to be receptive to commentary. It may be hypothesized, for instance, that algorithms were taught in a limited advanced education, presented as rate and labor problems in a school education, and then the applicability of each, and the components of each, were explored within professional environments. With labor, as seen in excavation texts like YBC 04663, a student would have become familiar with the need for and production of project statements to produce initial inputs into labor calculations, the use of labor rates to evaluate labor out of these project statements, and then the use of wage rates to evaluate wages out of this labor. These components of labor calculations could well be applied, with commentary, to the harvest of grain. This is, of course, conjecture, because of the nature of the proposed oral commentary—it would not be visible as mathematical practice

in the scribal tradition, only in the economic texts. Thus, a specialized professional education is suggested, reflecting further microcultural activity as well.

This specialization is certainly seen in the economic texts, as has been described. A more universal curriculum is witnessed with merchant activity, as suggested by both equivalency and interest calculation, both of which may have made use of rate tables. Even these calculations, however, show knowledge not entirely exhibited in the academic texts. Thus, even here, some learning was probably acquired in situ rather than entirely in the classroom.

The economic texts can help to understand the specialized education of scribes active in the bureau of irrigation and excavation, just as seen above with merchants. Coefficients used to define man-days of labor and then pay to be expended in excavations must have been memorized as part of this education. The addition of a multiplication table for 2:13:20, the reciprocal of 27 found on MS 3974, suggests that some additional numerical tables may have been memorized as well. It is difficult to say whether these were learned in a more universal elementary stage or as part of an advanced, professional education. Whatever the case, they were certainly incorporated into a professional environment. The coefficients used in YBC 12273 were similar to those found on the coefficient lists and problem texts, but depths associated with them differed, suggesting that part of a scribe's training in this bureau was in how to apply these coefficients in the field. Finally, scribes memorized algorithms used to calculate the volume of an excavation, and then labor and pay associated with this volume, like the models present in YBC 04663 and YBC 07164 discussed in Chap. 8. Commentary associated with these texts could explain the apprenticeship texts BM 085211 and BM 085238—they were produced in a professional environment, building on practices learned in an elementary and early advanced education. The numerous mistakes in transformation suggest the importance of this professional education, even with reference to the elementary education: it afforded the scribe time to hone skills learned in the classroom while introducing them to professional practice. In addition, the centesimal system was either learned with the professional education as well, or learned in the elementary scribal education and reinforced at this point. Education in the bureau of irrigation and excavation was probably a professional education that built on exercises common to the elementary and perhaps to some advanced educations but adapted through commentary for more specific purposes: irrigation and excavation works. This underlines the practicality of education as espoused by Michalowski (2012).

This phenomenon was not limited to the bureau of irrigation and excavation. A similar professional education existed in the grain storage bureau. Basic algorithms similar to interest rate problems were learned, which were then built on or adapted to calculations of sample measurement and change rate in an advanced, professional education. Text layouts were learned at this point. A similar structure could be applied to the scribes active in the grain production archive and grain harvest archive, where yield rates and then labor rates respectively must have been learned in an advanced, professional education, building on or adapting algorithms learned to compute labor, similar to those of the bureau of irrigation and excavation.

Text layout was learned here as well. Indeed, each bureau or archive presented in Chap. 4 seems to have presented its own practical knowledge, whether this was in addition to a traditional advanced scribal education or in lieu of this advanced education. Bureaus and archives required adherence to local standards that each actor had to accept. Each bureau provides evidence of Michalowski's hypothetical limited practical Old Babylonian scribal training, which produces the possibility of both a regional variety in education as well as variety based on profession and social status, and is largely borne out by the microcultural activity witnessed in this study.

How, then, was rounding numbers presented in the scribal curriculum? How was it adapted for administrative purposes? On the one hand, rounding was a tool used by scribes to limit potential discrepancy in a text. The scribes themselves were aware of observational, conceptual and systematic errors in the forms of measurement inconsistency, estimation and the use of approximate reciprocals for non-regular numbers in the texts. Rounding helped to mitigate these errors. On the other hand, as YBC 04224 and NBC 06763 show, rounding could be used to simplify a current or future calculation. This is exhibited in YBC 04698 statement 14, as presented above, where 59:24:30, the SPVN equivalent to 5 *ban* 9 1/3 *sila* 4 1/2 *gin*, was probably rounded up to 1, corresponding to 1 *bariga* in order to simplify calculation. Rounding, as a means to estimate value, also assisted movement between the cultures and microcultures as they existed in the kingdom of Larsa. For instance, rounding by means of truncation would have limited measurement inconsistency associated with remeasurement of value by different standards. However, while attempting to mitigate discrepancy, these same rounded values showed the same uncertainties associated with error. Thus, rounding itself produced error. Errors and mistakes associated with approximation and rounding on YBC 07473 underline this.

The rather systematic use of rounding suggests that it was an important feature of record keeping, one with customs and practices associated with it, that existed to help navigate the uncertain realm of error, to simplify calculations, to mitigate possible discrepancies between expected and actual values and, perhaps, to cross between cultural and microcultural boundaries. Thus, rounding numbers was fostered in the education system by the nature of the system itself: rounding was a means to limit discrepancies associated with adapting the mathematical world of potential into the real world. Rounding numbers was a means to cope with the system of mathematics as it was taught in the various educational milieus, to offset errors of estimation and evaluation in this system in order to produce realistic and usable results. Rounding, which is associated with observational errors, conceptual errors and systematic errors, proves that some errors could be based on agreed customs and practices in order to maintain acceptable deviations from a truth.

Appendix 1
Texts

This appendix presents editions in full and in part of texts studied here. Economic texts are presented in Sect. 1.A while mathematical texts appear in Sect. 1.B. Ordering is by museum number or publication when necessary (see Sect. 1.1 for how texts are labelled). When available, each text is provided the museum number, CDLI number, publication of copies, publication of editions, collation dates, and publication of date formula. with each text's commentary. As stated in Sect. 1.1, the Cuneiform Digital Library Initiative serves to catalogue cuneiform texts, often including high resolution photographs or copies and transliterations when available, publication information, collection information, and more. It can be found at https://cdli.ucla.edu/. With economic text, the date formula follow a standard format in the heading for each text: Regnal year, month, and then day. Thus NBC 05474 is dated *Sūmû-el* of Larsa year 14, month 07, day –. This means it is dated to the king of Larsa *Sūmû-el*'s fourteenth year in power (ca. 1881 BCE), the seventh month, but no day is referred to on the text itself. If the day or month is destroyed, it is listed as day or month 'xx'. If part of the date is broken, worn, or otherwise uncertain, what remains is stated followed by a question mark ($^{?}$) if a reading is uncertain (day $2^{?}$). 'No date formula' means the text is undated. The reader is referred to Chap. 1, especially Sect. 1.2 for chronology and the dates of the kings studied here. Because all mathematical texts are undated, there is no attempt to describe a date formula. In the text's description following the date formula and before the text itself appears, the scribe each text is associated with, as well as their appearance in Appendix 2 is stated.

R. Middeke-Conlin, *The Making of a Scribe*, Why the Sciences
of the Ancient World Matter 4, https://doi.org/10.1007/978-3-030-35951-5

1.A Economic Texts

Economic texts are divided between prosaic texts in Appendix 1.A.a and tabular texts in Appendix 1.A.b.

1.A.a

A.26371
CDLI number: Undefined
Copy: Stol 1982: no. 37
Edition: Stol 1982: 175, 176

Date formula: *Hammu-rābi* of Babylon year 40 (1753 BCE), month 05, day –.

A.26371, a contract perhaps from Larsa attributed to *Šēp-Sîn* B (Appendix 2.KK), the merchant overseer of Larsa, outlines a loan/disbursement of grain at interest which matures at harvest.

	Transliteration Obv	**Translation** Obv
1	2(diš) šu-ši 1(u) 5(aš) gur še-sag	2 sixties 15 *gur* flour$^{?}$
2	maš$_2$ 1(aš) gur 1(bariga) še daḫ-ḫe-dam	interest 1 *bariga* (per) 1 *gur* grain is to be added
3	i-na ^{geš}3(ban$_2$) gi-na	by means of the standard 3 *ban*-standard vessel
4	ki *še*$_{20}$-*ep*-^{d}Sîn ⸢ugula dam⸣-gar$_3$	from *Šēp-Sîn*, merchant overseer
5	^{I} ^{d}en-lil$_2$-ma-dingir	*Enlil-ma-ilum*
6	šu ba-an-ti	received
7	mu-ku$_x$(DU) u$_4$ buru$_{14}$-ka	delivery on the day of harvest
8	maš$_2$ 1(aš) gur 1(bariga) še-ta-am$_3$	the interest 1 *bariga* per 1 *gur* grain
9	i$_3$-ag$_2$-e	he will measure out
10	igi *li-pi*$_2$*-iṭ-i*$_3$*-li*$_2$-⸢*šu*⸣	before *Lipiṭ-ilīšu*
11	igi *e-ku-u*$_2$*-a*	before *Ekūya*
12	dumu *i-din*-^{d}bil$^{?}$-gi$^{?}$	son of *Iddin*-Gira$^{?}$
13	igi *si*$_2$*-si-i*	before *Sisî*
14	dumu e$_2$-a-*ga*-⸢*mil*⸣	son of *Ea-gāmil*
15	igi ^{d}nin-urta-*ga-mil*	before *Ninurta-gāmil*
16	dumu *an-na-a*	son of *Annâ*
17	igi *u-bar*-^{d}Šamaš	before *Ubār-Šamaš*
18	dumu giri$_3$-ni-i$_3$-sa$_3$	son on *Girni-isa*
19	iti ne-ne-gar	month 5
20	mu e$_2$ mes-lam	Year the temple of *Meslam* (*Hammu-rābi* year 40)

Small script on lower edge between line 9 and 10: kišib *e-ku-u*$_2$*-a*	Small script on lower edge between line 9 and 10: seal of *Ekūya*
Small script on left edge: kišib *li-pi*$_2$*-iṭ-i*$_3$*-li*$_2$*-šu*	Small script on left edge: seal of *Lipiṭ-ilīšu*

Notes

12 Stol's transliteration is tentatively followed here, although the wedges seem ambiguous at best. Perhaps also 'nagar x'.

LoE and LeE Stol notes these small scripts on the edges. These are insertions into the text and not the text itself so that each is placed below the actual text. These insertions qualify the official nature of this text.

AO 06760
CDLI number: P386834
Copy: Jean 1926: no. 017
Edition: Jean 1931: no. 127; Kozyreva 1988: 47ff; Breckwoldt 1994: Part V, 57
Collation, 08 April 2014

Date formula: *Rīm-Sîn* of Larsa year 02 (1821 BCE), month 05, day 30.

AO 06760, attributed to *Ubar-Šamaš* (Appendix 2.L), is a balanced account dated to *Rīm-Sîn's* second regnal year. Lines 3 through 8 of the capital section are similar to lines 1–4 of YBC 07473, which lists each of AO 06760's capital's in-silver value, in-kind value, and rate. This similarity could mean either the same transaction is referred to in both text, that is *Itti-Sîn-milki* took over the account described in AO 06760, or these capital sections represent a standard capital disbursement at this time. *Ubar-Šamaš* both receives the capital in lines 9 to 10 and disburses it in lines 59 to 60. Thus, he is probably the person who carried out calculations in the texts. The three in-silver rates for gold in lines 39 to 40, 45 to 46, and 49 to 51 are all 7 *gin* silver per 1 *gin* gold. This means in-kind rate for gold were neither necessary for this transaction, nor could they be calculated. Similar place names, as well as the similarities between this text and the capital section of YBC 07473, suggest that AO 06760 was produced in or around Larsa itself.

In lines 49 through 51 a discrepancy of 0.9 per cent appears between the expected total and the stated total. This discrepancy is compounded in line 59 where the expected total is either 14 *mana* 1/3 *gin* 25 *še* against the expected total silver in lines 49 through 51, a 0.85 per cent difference, or 13 5/6 *mana* 9 *gin* one-4th 10 *še* against the extant total, producing a 0.7 per cent difference.

In line 61, one expects 25 *še* at the end, not 24, a 0.002 per cent difference. The expected difference if line 59 if corrected is 4 *mana* 2 *gin* 25 *še*. If the total *še* in this line is adjusted, the author of this text subtracted from 13 5/6 *mana* 9 *gin* one-4th 10 *še*, which resulted in what is seen in the document, 4 *mana* 2 *gin* 24 *še*. This shows the total in lines 49 through 51 was a simple mistake. In addition, the discrepancy in lines 49 through 51 is not corrected in this tabulation so that it probably was a calculation mistake.

	Transliteration	**Translation**
	Obv	Obv
1	5/6 ma-na 7(diš) gin$_2$ igi 6(diš)-gal$_2$ ku$_3$-babbar	5/6 *mana* 7 *gin* one-4th silver
2	*si-i$_3$-tum* nig$_2$-ka$_9^{!}$ libir	balance of the old account
3	2(geš$_2$) še-giš-i$_3$	2×60 (*gur*) sesame
4	kar-bi 1(bariga) 1(ban$_2$) 5(diš) sila$_3$*-ta	its fixed rate 1 *bariga* 1 *ban* 5 *sila* per (*gin* silver)
5	ku$_3$-bi 8(diš) ma-na	its silver 8 *mana*
6	1(aš) gu$_2$ siki-gin	10 *gu* average wool
7	kar-bi 1(u) ma-na<-ta>	its fixed rate 10 *mana* <per> (*gin* silver)
8	ku$_3$-bi 1(diš) ma-na	its silver 1 *mana*
9	9 5/6 ma-na 7 [gin$_2$ igi-]6(diš)-gal$_2$ ku$_3$-babbar	9 5/6 *mana* 7 *gin* one-6th silver
10	šu-ti-a *u-bar-*^{d}Šamaš [dumu] dingir-*ba-ni*	receipt of *Ubār-Šamaš*, son of *Ilum-bani*
11	sag-nig$_2$-gur$_{11}$-ra ša$_3$-⸢bi-ta⸣	capital out of which
12	2(diš) ma-na *a-na kab-tu-um* ⸢x⸣[x x] ^{d}nanna	2 *mana* for *Kabtum-…* of Nanna
13	6(aš) gu$_2$ urudu kar-bi 6(diš) ma-na	6 *gu* copper, its fixed rate 6 *mana* per (*gin* silver)
14	ku$_3$-bi 1(diš) ma-na šu-ti-a ^{d}Sîn-*mu-pa-ḫi-ir*	its silver 1 *mana*, receipt of *Sîn-mupaḫḫir*
15	2(diš) ḫar-šu ku$_3$-babbar ki-la$_2$-bi 1/3 ma-na	2 bracelets of silver, their weight 1/3 *mana*
16	1(diš) ^{tug2}bar-dul$_8$ ku$_3$-bi 3(diš) gin$_2$	1 robe garment its silver 3 *gin*
17	*a-na ši-ir-pu-ni-i-nu-u$_2$-ma* dumu-munus dingir- / *ba-ni iš-li-mu*	for *Širpuninuma*, daughter of *Ilum-bani* when she / recovered
18	4(diš) gin$_2$ ku$_3$-gi kar-bi 9(diš) gin$_2$-ta-am$_3$	4 *gin* gold, its fixed rate 9 *gin* per (*gin* gold)
19	ku$_3$-bi 1/2 ma-na 6(diš) gin$_2$	its silver 1/2 *mana* 6 *gin*
20	šu-ti-a *ib-na-tum a-na* dumu-munus dingir-*ba-ni*	receipt of *Ibnatum*, for the daughter of *Ilum-bani*
21	3(bariga) i$_3$-nun kar-bi 1(ban$_2$) 5(diš) sila$_3$-ta	3 *bariga* butter, its fixed rate 1 *ban* 5 *sila* per / (*gin* silver)
22	ku$_3$-bi 1(u) 2(diš) [gin$_2$]	its silver 12 [*gin*]
23	šu-ti-a ir$_3$-[^{d}nanna]	receipt of Warad-[*Sîn*]
24	2(u) tug$_2$-ḫi-a kar-bi 3(diš) gin$_2$-ta	20 various garments its fixed rate 3 *gin* per / (garment)
25	ku$_3$-bi 1(diš) ma-na	its silver 1 *mana*
26	1(u) tug$_2$-ḫi-a kar-bi 5(diš) gin$_2$-ta	10 various garments its fixed rate 5 *gin* per / (garment)
27	ku$_3$-bi 5/6 ma-na	its silver 5/6 *mana*
28	1(diš) šu-ši ^{tug2}bar-sig$_9$ […] x	1 sixty barsig garments…
29	1(diš) šu-ši ^{tug2}bar-sig$_9$ dilib-ma	1 sixty hairy$^{?}$ barsig garments
30	kar-bi igi 4(diš)-gal$_2$-ta	its fixed rate one-4th per (garment)
31	ku$_3$*-bi 1/2 ma-na	its value 1/2 *mana*
32	⸢*ša**⸣ *a-na bi-tim ub-lu-u$_2$-nim*	which they brought into the household
33	1(geš$_2$) udu-nita$_2$ ku$_3$-bi 1/3 ma-na	1×60 rams its silver 1/3 *mana*
34	[*a-na*$^{?}$] ^{d}nanna *i-na* iti bara$_2$-zag-gar *in-na-ad-nu*	was given to Nanna in month 1
	Rev	Rev
35	1(u) 5(diš) gin$_2$ ku$_3$-babbar šu-ti-a ir$_3$-^{d}nanna	15 *gin* silver, receipt of *Warad-Sîn*
36	2(aš) gu$_2$ ^{urud}zabar kar-bi 6(diš) ma-na-ta	2 *gu* bronze, its fixed rate 6 *mana* (copper) per / (*gin* silver)
37	ku$_3$-bi 1/3 ma-na	its silver 1/3 *mana*
38	šu-ti-a *ib-na-tum*	receipt of *Ibnatum*
39	2(diš) gin$_2$ ku$_3$-gi kar-bi 7(diš) gin$_2$-ta	2 *gin* gold, its fixed rate 7 *gin* per (*gin* gold)
40	ku$_3$-bi 1(u) 4(diš) gin$_2$	its silver 14 *gin*
41	*a-na ri-ib*-di-*i-ša* dam *si-im-mu-ug-ra*	for *Rib-di-iša*, wife of *Simmugra*
42	1(bariga) 3(ban$_2$) i$_3$-nun kar-bi 1(ban$_2$) 5(diš) / sila$_3$-ta	1 *bariga* 3 *ban* butter its fixed rate 1 *ban* 5 *sila* / per (*gin* silver)
43	ku$_3$-bi 6(diš) gin$_2$	its silver 6 *gin*
44	šu-ti-a *ṣi-li$_2$-iš$_8$-tar*	Receipt of *Ṣillī-Ištar*
45	1/3 ma-na 9(diš) 5/6 gin$_2$ ku$_3$-gi	1/3 *mana* 9 5/6 *gin* gold
46	kar-bi 7(diš) gin$_2$-ta-am$_3$	its fixed rate 7 *gin* per (*gin* gold)
47	ku$_3$-bi 3(diš) 1/3 ma-na 8(diš) 5/6 gin$_2$	its silver 3 1/3 *mana* 8 5/6 *gin*

47	ku$_3$-bi 3(diš) 1/3 ma-na 8(diš) 5/6 gin$_2$	its silver 3 1/3 *mana* 8 5/6 *gin*
48	giri$_3$ *na-bi-i$_3$-li$_2$-šu*	transport of *Nabi-ilīšu*
49	1(u) 8(diš) 5/6 gin$_2$ 2(u) 5(diš) še ku$_3$-gi	18 5/6 *gin* 25 *še* gold
50	kar-bi 7(diš) gin$_2$-ta-am$_3$	its fixed rate 7 *gin* per (*gin* gold)
51	ku$_3$-bi 2(diš) ma-na 1(u) 1(diš) 1/2 gin$_2$ 2(u) / 5(diš) še	its silver 2 *mana* 11 1/2 *gin* 25 *še*
52	giri$_3$ *u-bar*-^{d}Šamaš	transport of *Ubār-Šamaš*
53	2(diš) tug$_2$-ḫi-a ku$_3$-bi 5(diš) 1/2 gin$_2$	2 assorted garments its silver 5 1/2 *gin*
54	5(diš) udu-nita$_2$ ku$_3$-bi 4(diš) 2/3 gin$_2$	5 rams its silver 4 2/3 *gin*
55	4(ban$_2$) i$_3$-nun ku$_3$-bi 2 2/3 gin$_2$	4 *ban* butter its silver 2 2/3 *gin*
56	*i-nu-ma ṣu-ḫa-ar-tum a-na bi-it* ur-^{d}nanna / *in-na-ad-nu*	When the girl was given to the household of / *Ur-Nanna*
57	šu-ti-a *ṣi-li$_2$*-^{d}Šamaš	Receipt of *Ṣillī-Šamaš*
58	1/3 ma-na ku$_3$-babbar *a-na* an-na šu-ti-a *ib-na-tum*	1/3 *mana* silver for tin receipt of *Ibnatum*
59	1(u) 3(diš) 5/6 ma-na 6(diš) gin$_2$ igi 4(diš) gal$_2$ / 1(u) še	13 5/6 *mana* 6 *gin* one-4th 10 *še*
60	ki *u-bar*-^{d}Šamaš ba-zi	from *Ubār-Šamaš* disbursed
61	diri 4(diš) ma-na 2(diš) gin$_2$ 2(u) 4(diš) še / ku$_3$-babbar	excess 4 *mana* 2 *gin* 24 *še* silver
62	ki bara-zag-gar u$_4$ 1(u) 6(diš)-kam	month 1 day 16
63	mu e$_2$ ^{d}Adad ša$_3$ larsa^{ki}-ma	Year the temple of Adad and
64	e$_2$ ^{d}bara$_2$-ul-e-gar-ra ša$_3$ zar-bi-lum^{ki}	the temple of Baraulegarra in *Zarbilum*
65	u$_3$ ^{urud}alan ir$_3$-^{d}Sîn lugal e$_2$ gal-bar-ra-še$_3$	and brought a copper statue of *Warad-Sîn* into the
66	i-ni-in-ku$_4$-re	temple of Baraulegarra (*Rīm-Sîn* year 2)

Notes

2 One expects ka$_9$ which the traces do not allow.

4 sila$_3$ in this line clearly shows all three wedges upon inspection of the tablet.

16 I am unaware of any other occurrence of ^{tug2}bar-dul$_8$ besides YBC 07473: 41’. However, for ^{tug2}bar-dul$_5$, see Waetzoldt (2010: 207) where it is described as a kind of soft fabric or a coat or long coat.

18–19 Note the use of –ta-am$_3$ to denote the in-silver rate against every other use of simple –ta without –am$_3$ to express the same kind of rate as well as in-kind rates in this document. For the use of ta-am$_3$ in the Ur III period, see Snell (1982: 39).

28, 29 This variety of garment is discussed by Michel and Veenhof (2010: 238) as a textile traded by Old Assyrian merchants in Anatolia, a kind of scarf or headdress. It is also discussed by Beaugeard (2010: 288) where it is described as a kind of light scarf commonly worn at Mari.

31 A collation of the tablet itself shows a clear, unbroken ku$_3$ at the beginning of this line.

32 Collation of the tablet shows traces of ša at the beginning of this line.

51 Collation reveals an erasure of ‘ku$_3$ X’, probably ku$_3$-bi.

AO 07034
CDLI number: P386856
Copy: Jean 1926: no. 039
Edition: Kozyreva 1988: 180 (Transliteration); Breckwoldt 1994: Part V, 62–64
Collation: 15 April 2013; Arnaud 1976: 85

Date formula: *Rīm-Sîn* of Larsa year 14 (1809 BCE), month 10, day –.

AO 07034, a balanced account attributed to *Šēp-Sîn* A (Appendix 2.T) and probably from Larsa, primarily renders disbursements to individuals, although the purchase of items is denoted in several line.

	Transliteration	**Translation**
	Obv	Obv
1	1/2 ma-na 4(diš) 1/2 gin$_{2}$ 1(u) ⸢5(diš) še ku$_{3}$- / babbar⸣	1/2 *mana* 4 1/2 *gin* 15 *še* silver
2	1/2 ma-na 4(diš) 1/2 gin$_{2}$* 1(u) 5(diš) še	1/2 *mana* 4 1/2 *gin* 15 *še*
3	sag-nig$_{2}$-gur$_{11}$-ra ša$_{3}$-bi-ta	capital out of which
4	2(diš) gin$_{2}$ ^{d}Sîn-*ma-gir* giri$_{3}$ lu$_{2}$ maš-gan$_{2}$-šabra^{ki}	2 *gin Sîn-māgir*, transport of the man of Maškan / -Šapir
5	2(diš) ⸢gin$_{2}$⸣ *pa-la-šu-li-ri-ik i-nu-ma a-na* uru^{ki} / *ra-ḫa-bu-um* /<*il*>*-li-ku*	2 *gin Palāšu-līrik* when to *Al-Raḫabum* /<he>went
6	1(diš) 1/3 gin$_{2}$ sa$_{10}$ 5(diš) ^{na4}sikil	1 1/3 *gin* price of 5 sikil-stones
7	1(diš) gin$_{2}$ sa$_{10}$ tug$_{2}$ *a-na* ^{d}Sîn-*šar-ma-tim*	1 *gin* price of a garment for *Sîn-šar-mātim*
8	4(diš) 1/2 gin$_{2}$ sa$_{10}$ 1(u) 5(diš) ^{giš}mar^{urudu} giri$_{3}$ *ṣi-* / *-li$_{2}$* -iš$_{8}$-tar	4 1/2 *gin* price of 15 copper shovels transport of / *Ṣillī-Ištar*
9	3(diš) gin$_{2}$ dumu^{meš} *si-im-mu-ug-ra*	3 *gin* citizens of *Simmugra*
10	1/2 gin$_{2}$ dumu *la-li-i-a* šu-ku$_{6}$	1/2 *gin* the son of *Lalia*, the fisherman
11	1/2 gin$_{2}$ munus lu$_{2}$ gub-ba *ša* ^{d}Ištar za-unug^{ki}	1/2 *gin* the female and male ecstatics of Ištar / of *Zarbilum*
12	1/2 gin$_{2}$ ^{d}Sîn-*i-te-er i-nu-ma a-na i$_{3}$-si-in*^{ki} še$^{?}$[…]	1/2 *gin Sîn-iter* when to Isin […]
13	1(diš) gin$_{2}$ lu$_{2}$ šu-uk-ma-an-ṣi-ir$^{?}$	1 *gin* the man of *Šuk-manṣir*
14	*i-nu-ma* ^{d}Šamaš-*ub-lam u$_{2}$-te-er-ru-nim*	When they brought back *Šamaš-ublam*
15	1(diš) 1/2 gin$_{2}$ *a-na* kaš *a-na e-pe-eš ši-ip-ri-im*	1 1/2 *gin* for beer for doing work
16	1(u) 5(diš) še sa$_{10}$ ur$_{2}$ *a-na a-ka-al a-wi-lim*	15 *še* price of the base$^{?}$ for the food of the citizen
17	1(diš) gin$_{2}$ lu$_{2}$ *nu-ur$_{2}$*-^{d}Šamaš *ša* dumu^{meš}	1 *gin* the man of *Nūr-Šamaš* who the sons of
18	^{d}Sîn-sipa *ir-de-a-am*	*Sîn-rē'î* accompanied
19	1(diš) gin$_{2}$ 1(u) 5(diš) še sa$_{10}$ tug$_{2}$ *a-na* ^{d}Sîn-sipa	1 *gin* 15 *še* price of a garment for *Sîn-rē'î*
20	1(diš) gin$_{2}$ lu$_{2}$ dam *li-pi-it-iš$_{8}$-tar$_{2}$*	1 *gin* the man of the wife of *Lipit-Ištar*
21	*ša* 4 geme$_{2}$ ir$_{3}$-ḫi-a *ir-de-a-am*	who accompanied 4 various female and / male slaves
22	igi 4(diš)-gal$_{2}$ 9(diš) še sa$_{10}$ 1(bariga) kaš-ta	one-4th 9 *še* price from 1 *bariga* beer
23	*a-na* ^{lu2}azlag^{meš}	for the textile cleaners
24	[igi] 4(diš)-gal$_{2}$ 9(diš) še ⸢sa$_{10}$⸣[…]	one-4th 9 *še* price of […]
	Rev	Rev
25	*a-na* GIŠ[…]	for…
26	1(u) 8(diš) še sa$_{10}$ 2(ban$_{2}$) kaš *ša* ⸢*a-na*⸣[…]	18 *še* price of 2 *ban* beer which for…
27	*u$_{3}$ i$_{3}$-li$_{2}$-i-ma*[…]	and *Ilī-ima*[…]
28	2(u) še sa$_{10}$ ^{uzu}ur	20 *še* price of dog meat$^{?}$
29	1/2 gin$_{2}$ šu-ku$_{6}$ *ša* ku$_{6}$ *ub-lam*	1/2 *gin* the fishermen who brought fish
30	3(diš) gin$_{2}$ sa$_{10}$ gada	3 *gin* price of linen
31	2(diš) gin$_{2}$ sa$_{10}$ nag$^{?}$ *a-na* lu-ku-ur e$_{2}^{?}$-a	2 *gin* price of drinks for the *nadītum* of Ea

32	1(diš) gin$_2$ *ḫa-zi-rum* šu-ku$_6$	1 *gin Ḫāzirum*, fisherman
33	1(diš) gin$_2$ *še-rum-ba-ni*	1 *gin Šērum-bani*
34	1(diš) gin$_2$ *a-na* dalla ku$_3$-babbar *u$_3$ kam-kam-ma-* / *tum* ku$_3$-babbar	1 *gin* for a silver crown and silver ring
35	*a-na* dam ^{d}Sîn-*mu-pa-ḫi-ir i-nu-ma* / *a-na ši- im-tim*	for the wife of *Sîn-mupaḫḫir* when / (he) died
36	1(diš) 1/2 gin$_2$ *a-na i-ni-a-tum*	1 1/2 *gin* for *Iniatum*
37	giri$_3$ *ṣi-li$_2$-iš$_8$-tar$_2$*	transport of *Ṣillī-Ištar*
38	1/2 ma-na 1(diš) 2/3 gin$_2$ 1(u) 5*(diš) še	1/2 *mana* 1 2/3 *gin* 15 *še*
39	iti še-kin˹-ku$_5$˺	month 10
40	mu ugnim unug^{ki} *i-si-in*^{ki}	Year the armies of Uruk, Isin,
41	tin-tir^{ki} ^{giš}tukul ba-an-sig$_3$	(and) Babylon were smitten with weapons / (*Rīm-Sîn* year 14)

Notes

2 Collation revealed this sign looks more like ‘gin$_2$’ than ‘šu’.

5, 6 <*il*>-*li-ku* in line 5 is placed at the end of line 6 on the tablet, following Breckwoldt (1994: 62). The scribe somehow omitted the initial IL sign and so this solution is tentative.

6 ^{na4}sikil is understood here as a kind of semi-precious gem, see CAD (S: 43, 44) and Black et al. (2000: 322) (*sikillu*). Kozyreva reads ‘na$_4$-ḫar-zi$^{!}$-bi-še’.

16 ur$_2$ is uncertain. It is not bappir$_2$ as suggested by Breckwoldt (1994: part V, 63) even if this would make sense in this context. Nor is it ur, translated as ‘dog’ in line 28.

28 ^{uzu}ur is translated here as ‘dog meat’. For the meaning of ur as dog, see Steinkeller (1995/1996: 212, 213). Uzu is translated as *širu*, ‘meat’, in CAD (Š III: 113, 118–121).

38 Collation shows 1(u) 5(diš) še not 1(u) 4(diš) as the copy shows.

AO 08461
CDLI number: P386930
Copy: Jean 1926: no. 115
Collation 15 April 2013

Date formula: *Rīm-Sîn* of Larsa year 57 or 58 (1766 or 1765 BCE), month uncertain, day uncertain.

This unfortunately broken text, attributed to scribe N (Appendix 2.DD) and probably from around Larsa, presents an account of grain rations.

	Transliteration	**Translation**
	Obv	Obv
1	2(aš) ⸢1+(bariga)⸣ […]	2 *gur* 1+ *bariga* […]
2	2(aš) 2(bariga) […]	2 *gur* 2 *bariga* […]
3	2(aš) […]	2 *gur* […]
4	1(aš) ⸢gur⸣ […]	1 *gur* […]
5	2(aš) ⸢gur⸣ […] ni […] x	2 *gur* […]
6	1(aš) ⸢gur⸣ [*nu*-]*ur*$_2$-^{d}Ištar x	1 *gur* [*Nū*]*r-Ištar*, x
7	2(aš) ⸢gur x x x⸣	2 *gur* …
8	1(aš) […]	1 *gur* […]
9	1(aš) […]	1 *gur* […]
10	2(aš) […]	2 *gur* […]
11	4(bariga$^{?}$) […]	4 *bariga*$^{?}$ […]
12	4(bariga$^{?}$) […]	4 *bariga*$^{?}$ […]
13	4(bariga$^{?}$) […]*	4 *bariga*$^{?}$ […]
	Break	Break
14’	2(bariga) […]*	2 *bariga* […]
15’	2(bariga) […]	2 *bariga* […]
16’	4(bariga$^{?}$) […]	4 *bariga*$^{?}$ […]
17’	2(bariga$^{?}$) lu$_2$ […]	2 *bariga*$^{?}$ lu-[…]
18’	1(bariga$^{?}$) 3(ban$_2$) ⸢ur$_2$⸣ […]	1 *bariga*$^{?}$ 3 *ban* ur-[…]
19’	1(bariga$^{?}$) 5(ban$_2$) ⸢ur$_2$⸣ […]	1 *bariga*$^{?}$ 5 *ban* ur-[…]
20’	1(bariga$^{?}$) 1(ban$_2$) ⸢ur$_2$⸣ […]	1 *bariga*$^{?}$ 1 *ban* ur-[…]
	LoE	LoE
21’	šu-nigin 2(u) 4(aš) 3(bariga) 1(ban$_2$) gur še ba-⸢zi⸣	total 24 *gur* 3 *bariga* 1 *ban* rain disbursed
	Rev	Rev
22’ 23’	8$^{?}$(aš) 3(bariga) gur še ša$_3$-gal gu$_4$-ḫi-a *ša* u$_4$ 43-kam	8 *gur* 3 *bariga* grain oxen fodder of 43 days
24’	4(bariga) 3(ban$_2$) še duḫ *ša* u$_4$ 1(u) kam 1(diš) / 3(ban$_2$)-ta-am$_3$	4 *bariga* 3 *ban* grain bran of 10 days, 1 (day) / per 3 *ban*
25’	4(bariga) šuku *i*$_3$-*li*$_2$-sukkal *sa* u$_4$ 2(diš)-kam	4 *bariga* rations of *Ilī-sukkal* for day 2
26’	3(bariga) šuku lu$_2$ elam-ma^{ki} u$_4$ 2(diš)-kam	3 *bariga* rations of the Elamite for day 2
27’	2(bariga) lu$_2$ *al-tar ša*$^{!}$ a-ša$_3$ *mu-uš-ta-al*	2 *bariga* workers of the field of *Muštāl*
28’	1(bariga) šuku *ma-a-nu-um* šeš ^{d}Sîn-*ma-gir*	1 *bariga* ration of *Mannum*, brother of *Sîn-* / *māgir*
29’	1(ban$_2$) lu$_2$ ^{giš}ma$_2$ *i-nu-u*$_2$*-ma an-ši-me*$^{?}$*-ea-tum*	1 ban boatmen when *Anši-meatum*
30’	*a-na* uru^{ki} e$_2$-maḫ *il-li*	goes up to *al*-Emaḫ
31’	1(ban$_2$) eš$_2$ geme$_2$$^{?}$ *ma-ga-ru-um ša an-ši-me*$^{?}$*-ea-tum*	1 *ban* flour for the compliant$^{?}$ female slave$^{?}$ of
		/ *Anši-meatum*
32’	2(ban$_2$) lu$_2$ ^{giš}ma$_2$ *ša* giš ⸢x x x tum$_3$⸣*	2 *ban* boatmen who brought up…
33’	3(ban$_2$) lu$_2$ ^{giš}ma$_2$ *ša* ⸢x x x x⸣*	3 *ban* boatmen who…
34’	2(ban$_2$) lu$_2$ ^{giš}ma$_2$ *ša* [...]*	2 *ban* boatmen who […]
35’	2(ban$_2$) *i*$_3$-*li*$_2$-U$_3$-dingir[...]*	2 *ban Ilī-u-Anum*
36’	1(ban$_2$) erin$_2$ *ir-ḫ u-um* u$_4$ 1(u) 1(diš)[…]*	1 *ban* quick$^{?}$ troops day 11+[…]
37’	7 sila$_3$ šuku *i*$_3$-*li*$_2$-*i-din-nam*[…]*	7 *sila* ration of *Ilī-iddinam* […]
38’	1(bariga) še šuku *i-ni-*⸢x⸣ […]*	1 *bariga* grain ration of *Ini*[…]
39’	1(bariga) še lu$_2$ *al*-tar *ša* a-ša$_3$ šuš$_4$-ḫi-li	1 *bariga* grain workers of the field of Šuš-hili
40’	2(bariga) še bulug$^{?}$ *a-na* še-numun	2 *bariga* grain to sew as seed-grain
41’	1(bariga) *ma-a-nu-um* šeš ^{d}Sîn-*ma-gir*	1 *bariga Mannum*, brother of *Sîn-māgir*
42’	šu-nigin 1(u) 2(aš) 4(bariga) 3(ban$_2$) gur 7(diš) sila$_3$ / še ba-zi	total 12 *gur* 4 *bariga* 3 *ban gur* 7 *sila* grain / disbursed
43’	^{I} *i*$_3$-*li*$_2$-sukkal	*Ilī-sukkal*
44’	*u*$_3$ *wa-tar*-^{d}Šamaš	and *Watar-Šamaš*

	UpE	UpE
45’	iti gan-e$_3$-a u$_4$ 7(diš)-kam	month 9 of Larsa day 7
46’	*u*$_3$ u$_4$-um e$_3$-a u$_4$ 3(u)-kam	and day of Larsa day 20
47’	mu 28+[…]	year 28+… (*Rīm-Sîn* 57$^?$)
	LeE	LeE
48’	šu-nigin 3(u) ⌜7(aš)⌝ gur 2(bariga) 4(ban$_2$) / 7(diš) sila$_3$ še *ša* ir$_3$-*šu-a-bu-šu* ba-zi	Total 37 *gur* 4 ban 7 sila grain which / *Waradšu-abūšu* disbursed

Notes

13, 14 Collation revealed 4(bariga) and 2(bariga) respectively in these lines. Approximately five lines are missing between the two.

27’ While the copy shows engur, it seems, following line 36, that the author intended to render *ša*, Akkadian ‘of’.

29’, 30’ For the city, George (1993: 120, entry 730) states that it is a town named after the sanctuary, probably near Larsa by citing this passage.

33’–38’ These lines upon collation revealed much more than the copy in Jean 1926 showed. This is reflected in the transliteration.

AO 08464
CDLI number: P386887
Copy: Jean 1926: no. 072
Edition: Breckwoldt 1994: part V, 72, 73; Jean 1931: no. 128; Leemans 1960: 150–152; Middeke-Conlin 2014: § 5.3.1.6
Collation: Arnaud 1976: 86. In conservation when visited the Louvre

Date formula: *Rīm-Sîn* of Larsa year 27 (1796 BCE), month 11, day –.

AO 08464 is attributed to *Itti-Sîn-milki* the merchant overseer of *Zarbilum* (Appendix 2.H). It lists a series of transactions delivered by *Itti-Sîn-milki*, to *Ikūn-pī-Adad* and *Ilī-iddinam*. In this text, in-kind items are evaluated in silver by means of an equivalency rate.

There are two possible instances of rounding in AO 08464: lines 6–7 and 31–32. A collation of this text by Leemans (1960: 151, 152) would show the correct value in lines 6 through 7 and a simple mistake in lines 31 through 32. However, the corrected value is uncertain in lines 6 through 7, which leaves a question here of whether Leemans or Jean is correct. Perhaps a further collation would solve this, although at the moment of writing a collation is impossible. This shows a difficulty with the texts: differentiating an ancient mistake from a modern mistake can be difficult due to the nature of some texts. They may be or have devolved into such a poor state since an initial examination that re-evaluation of evidence is impossible. Thus, the nature of a discrepancy cannot always be determined. Possible rounding would amount to 0.03 per cent difference while total difference would be 2.22 per cent.

	Transliteration	**Translation**
	Obv	Obv
1	3(diš) ma-na ku$_3$-babbar	3 *mana* silver
2	8(diš) gin$_2$ ku$_3$-gi kar 4(diš) gin$_2$	8 *gin* gold fixed rate 4 *gin* (per *gin* gold)
3	ku$_3$-bi 1/2 ma-na 2(diš) gin$_2$	its silver 1/2 *mana* 2 *gin*
4	5(diš) gin$_2$ ku$_3$-gi kar 3(diš) gin$_2$	5 *gin* gold fixed rate 3 *gin* (per *gin* gold)
5	ku$_3$-bi 1(u) 5(diš) gin$_2$	its silver 15 *gin*
6	4 (aš) 1 (ban$_2$) gur i$_3$-geš kar 1(ban$_2$) 8(sila$_3$)	4 *gur* 1 *ban* common oil fixed rate 1 *ban* 8 (*sila* / per *gin* silver)
7	ku$_3$-bi 1 ma-na 7(diš) gin$_2$ igi 6-gal$_2$ / 1(u) še*	its silver 1 *mana* 7 *gin* one-6th /10 *še*
8	1(bariga) 1(diš) sila$_3$ i$_3$-sag kar 5(diš) gin$_2$	1 *bariga* 1 *sila* premium oil fixed rate 5 *gin* (per / *gin* silver)
9	ku$_3$-bi 1(u) 2(diš) gin$_2$ igi 6(diš)-gal$_2$ / 6(diš) še	its silver 12 *gin* one-6th 6 *še*
10	1(ban$_2$) šim kar 3(diš) sila$_3$ ku$_3$-bi 3(diš) 1/3 gin$_2$	1 *ban* perfumed oil fixed rate 3 *sila* (per *gin* / silver) its silver 3 1/3 *gin*
11	1(u) ma-na $^{\text{giš}}$eren	10 *mana* cedar
12	1(u) ma-na $^{\text{giš}}$za-ba-al	10 *mana* juniper (excelsa)
13	1(u) ma-na $^{\text{giš}}$šu-ur$_2$-min$_3$	10 *mana* cypress
14	1(u) ma-na $^{\text{giš}}$li-wi-ir	10 *mana* white cedar
15	kar 1(u) 2(diš) ma-na ku$_3$-bi 3(diš) 1/3 / gin$_2$	fixed rate 12 *mana* (per *gin* silver) its / silver 3 1/3 *gin*
16	4(ban$_2$) 2(diš) sila$_3$ šim-ḫi-a kar 1(bariga)	4 *ban* 2 *sila* mixed perfumes fixed rate 1 *bariga* / (per *gin* silver)
17	ku$_3$-bi 2/3 gin$_2$ 6(diš) še	its silver 2/3 *gin* 6 *še*
	Rev	Rev
18	⸢4(u)*⸣ udu-nita$_2$ kar 2/3 gin$_2$	40 rams fixed rate 2/3 *gin* (per ram)
19	ku$_3$-bi 1/3 ma-na <6(diš) 2/3 gin$_2$>	its silver 1/3 *mana* <6 2/3 *gin*>
20	1(geš$_2$) 7(diš) udu-nita$_2$ kar 1/2 gin$_2$	1×60+7 rams fixed rate 1/2 *gin* (per ram)
21	ku$_3$-bi 1/2 ma-na 3(diš) 1/2 gin$_2$	its silver 1/2 *mana* 3 1/2 *gin*
22	9(diš) udu-nita$_2$ bar-sud kar 1/3 gin$_2$	9 rams without fleece fixed rate 1/3 *gin* (per ram)
23	ku$_3$-bi 3(diš) gin$_2$	its silver 3 *gin*
24	1(geš$_2$) 3(u) 9(diš) ganam$_4$ kar 1/2 gin$_2$	1×60+39 ewes fixed rate 1/2 *gin* (per ewe)
25	ku$_3$-bi 2/3 ma-na 9 1/2 gin$_2$	its silver 2/3 *mana* 9 1/2 *gin*
26	1(u) ganam$_4$ bar-sud kar igi 4(diš)-gal$_2$	10 ewes without fleece fixed rate one-4th (*gin* per / ewe)
27	ku$_3$-bi 2(diš) 1/2 gin$_2$	its silver 2 1/2 *gin*
28	1(u) 6(diš) sila$_4$ kar 1/3 gin$_2$ ku$_3$-bi 5(diš) 1/3 gin$_2$	16 lambs fixed rate 1/3 *gin* (per lamb) its silver 5 / 1/3 *gin*
29	3(u) 4(diš) maš$_2$-nin$_9$ kar 1/3 gin$_2$	34 female *nin*-goats fixed rate 1/3 *gin* (per goat)
30	ku$_3$-bi 1(u) 1(diš) 1/3 gin$_2$	its silver 11 1/3 *gin*
31	šu-nigin 7(diš) 1/3 ma-na 5(diš) 1/3 gin$_2$	total 7 1/3 *mana* 5 1/3 *gin*
32	2(u) 2(diš)* x ⸢x⸣	22 …
33	mu-ku$_x$(DU) *it-ti*-^{d}Sîn-*mil-ki*	delivery of *Itti-Sîn-milki*
34	giš-tag-ga lugal	royal sacrifice
35	iti udru (ZIZ$_2$.A)	month 11
36	šu-ti-a *i-ku-un-pi$_4$*-^{d}Adad	receipt of *Ikūn-pī-Adad*
37	*u$_3$ i$_3$-li$_2$-i-din-nam*	and *Ilī-iddinam*
38	iti udru (ZIZ$_2$.A)	month 11
39	mu «e$^?$» i$_7$ gu$_3$-nun-di[…]	year the canal ‘that roars strongly’
40	ba-ra-si $^{(?)}$[…]	has been dug? (*Rīm-Sîn* year 27$^?$)

Notes

6 Arnaud's collation suggests 8(diš) gin$_2$ at the end of this line, although this seems unlikely. If so, 1/2 (*mana*) 8 *gin* or 1 *ban* 8 *gin* would be expected. Neither is supported by the text.

7, 81(u) še was placed next to line 8, possibly due to a lack of space (collation needed) as suggested by Leemans followed by Breckwoldt (1994: part V, 72), who suggests 7 1/6 *gin* 10 *še* Leemans (1960: 151, 152) for this line.

18, 19 Both Arnaud's collation as well as Leemans' review (1960: 151) suggest 4 (u) at the beginning of this line.

19 zi(?)-nin according to Jean 1931, no. 128.

29 The sign after maš$_2$ looks more like a nin$_9$ than a munus aš$_3$ as Breckwoldt transliterates.

31, 32 The total here may be rounded down if Jean's copy is correct. However, Leemans notes the text is clearly 2(u) 2(diš), against the copy in Jean 1926. Leemans (1960: 151, note 3) would further prefer to restore ku$_3$-babbar after it, even though he states, 'the traces hardly allow this reading'. If Leemans is correct then the number would have to be a simple mistake, that is, the author meant to write 1/2 gin$_2$ instead of 1/3 gin$_2$.

34 For giš…tag as 'to sacrifice', see Thomson (1984: 318). Breckwoldt (1994: part V, 68, note 10) suggests this phrase is derived from 'to offer'.

AO 08493
CDLI number: P386922
Copy: Jean 1926: no. 107
Edition: Jean 1931: no. 114 lines 1–8; 16–36; Breckwoldt 1994: Part V, 85–86
Collation 15 April 2013; Arnaud 1976: 87

Date formula: *Rīm-Sîn* of Larsa year 51 (1772 BCE), month 04, day –.

AO 08493 is a balanced account, probably produced in Larsa, of grain from the archive of *Sîn-rāmā* (Appendix 2.CC). This text uses the first person throughout to describe transactions. Note also the capital section, which seems to deal with two parts, one of which is unfortunately broken. The author states that the 'king' calculated out a tax at a specific rate, for which see Sect. 8.1. A second rate seen in the text itself is, unfortunately, too broken to warrant an examination.

	Transliteration Obv	**Translation** Obv
1	1(aš) 1(bariga) 4(ban$_2$) gur še	1 *gur* 1 *bariga* 4 *ban* grain,
2	*na-am*$^{!}$*-ḫa-ar-ti* 2(u) gur še	the revenue of 20 *gur* grain
3	*ša i-na* 1(aš) gur še 2(ban$_2$) še *šar-rum u*$_2$*-pi-iš-šu-ma*	which from 1 *gur* grain 2 *ban* grain the king / calculated it and
4	*a-na* e$_2$ sikil$^{?}$-li *ša id-di-nu*	gave to the e-sikilli$^{?}$,
5	še-ba ^{d}Sîn-*ra-ma*	(is) the grain ration of *Sîn-rāmā*
6	*ša i-na* aš-dub-ba^{ki} *am-ḫu-ru*	that I accepted in Ašdubba.
7	*i-di* anše-ḫi-a *a-bu-ul-lam*	The fee of the donkeys, gate,
8	*u*$_3$ *ṣi-ta-am a-pu-ul-ma*	and exit I paid.

9	1(aš) 1(bariga) 2(ban$_2$) gur *ša i-na* larsa^{ki} / *u$_2$-ša$^{!}$-an-nu*	1 *gur* 1 *bariga* 2 *ban* which I remeasured in / Larsa
10	šu-ti-a *ma-an-ni-ia*	(is) the receipt of *Manniya*
11	[*u$_3$*] ^{d}Sîn-*ra-ma*	[and] *Sîn-rāmā*
12	[...]u$_4$ 26-kam	...day 26
13	[mu ki] 21 i-si-in[^{ki}]	[year] 21 Isin (*Rīm-Sîn* year 50)
	Rev	Rev
14	sag-nig$_2$-gur$_{11}$-ra ša$_3$-bi-ta	capital, out of which
15	⸢1$^{?}$(bariga) x⸣ še *ku-<ru>-ma-at* ^{d}Sîn-*ra-ma*	1 *bariga* … grain allocation of *Sîn-rāmā*
16	[*ša*] *a-na* unug^{ki} *u$_3$* e$_2$ dingir-re-e-ne	[which] to Uruk and temples of the gods
17	[...] ša$_3$ Larsa^{ki} giri$_3$ ^{d}Ištar-*na-aḫ-ra-ri i-na* / ⸢*mu*⸣[-*ši*]⸢-*im*⸣	[...] in Larsa transport of *Ištar-Naḫrari* in the / night
18	iti sig$_4$-a u$_4$ ⸢x x⸣ mu ki 21 i-si-in^{ki}	month 3 day … year 21 Isin (*Rīm-Sîn* year 50)
19	5(ban$_2$) še *a-na ta-ku-ul-tim u$_3$* ninda⸢*ṣe$_2$-er-pe-*⸣[*tim*]	5 *ban* grain for (cultic) meal and barley soup
20	*i-nu-ma zi-kir-i$_3$-li$_2$-šu i-mu-tu*	when *Zikir-ilīšu* died
21	giri$_3$ *a-na-*^{d}Ištar-*ap-qid* iti ne-ne-gar u$_4$ 12$^{?}$ -kam	transport of *Ana-Ištar-apqid* month 5 day 12$^{?}$
22	1(bariga) še ki 3 *a-na* unug^{ki} ⸢giri$_3$* a*-na*-^{d}Ištar*- / ap*-qid*⸣	1 *bariga* grain 3rd to Uruk transport of *Ana-* / *Ištar-apqid*
23	*ša* 3(ban$_2$)-ta-am$_3$ a*-ra$_2$* 2-⸢kam⸣ *i-na* iti gan-gan-e	of 2 instalments of 3 ban each in the month 9
24	*u$_3$ i-na* iti udru (ZIZ$_2$.A) *ad-di-nam*$^{?}$ [...]	and in month 11 I gave
25	2(bariga) 5(ban$_2$) šu-ti-a *pi-iš-ti-ia* mu ki-21 / i$_3$-si-«in»^{ki} (*Rīm-Sîn* year 50)	2 *bariga* 5 *ban* receipt of *Pištiya* year 21 Isin
26	1(bariga) še *ša a-na* ^{d}*ki-it-tum-li-iz-zi-iz*	1 *bariga* grain which to *Kittum-līzziz*
27	^{munus}a-zu *ad-di-nu*	the (female) doctor I gave
28	giri$_3$ ^{d}Ištar-*um-mi-e-ni-iš-*⸢*tim*⸣	transport of *Ištar-ummī-eništim*
29	iti sig$_4$-a u$_4$ 2(u) 1(diš)-kam mu ki 2(u) 2(diš) i$_3$-si-in^{ki}	month 3 day 21 year 22 Isin (*Rīm-Sîn* year 51)
30	1(bariga) še *ša a-na zi-nu-u$_2$* munus šag$_4$-ba ⸢x x⸣	1 *bariga* grain which to *Zinnu*, the pregnant / woman...
31	giri$_3$ *nu-ur$_2$-i$_3$-li$_2$-šu* iti šu-numun-a	transport of *Nūr-ilīšu* month 4
32	2(bariga) še *i-nu-ma* ^{d}Sîn-*ra-ma*	2 *bariga* grain when *Sîn-rāmā*
33	*im-ra-ṣu*	became ill
	RiE$^{?}$	RiE$^{?}$
34	4(bariga) 5(ban$_2$) še ki *ma-an-ni-ia*	4 *bariga* 5 *ban* from *Manniya*
35	šu-ti-a ^{d}Sîn-*ra-ma* iti šu-numun-a ki 2(u) 2(diš) / i$_3$-si-in^{ki}	receipt of *Sîn-rāmā* month 4 year 22 Isin / (*Rīm-Sîn* year 51)
36	*si-i$_3$-tum* 1(bariga) 3(ban$_2$)	balance 1 *bariga* 3 *ban*

Notes

2 What must be 'am' looks more like 'bi'.

4 The reading of sikil is very uncertain. It looks possibly like dam as well. However, the use of li afterward is quite clear in support of sikil.

9 ša is clearly intended even though DU is written. The final -nu in this line runs into še written in line 34 of the right edge.

15 The beginning of this line is uncertain. There is an extra sign between 1(bariga) and še of which the reading is difficult. One possibility is 2+(ban$_2$), although this seems unlikely with the subtotal of line 25. Indeed, the reading of še is uncertain as a wedge runs into it as well. Further difficulty appears in the following three signs. The reading *kurumat* is tentative, although it seems that this line is referring to a specific allocation for the express purpose of *Sîn-rāmā*.

22 Breckwoldt suggests adding in the broken and worn ending giri$_3$ *a-na-*^{d}Ištar-*ap-qid* which is confirmed on collation.

23 a-ra$_2$ 2-kam, again proposed by Breckwoldt, is confirmed on collation.
24 final -nam is not certain.
25 Isin, written at the end of 25 and 26, lacks the typical '-in'.
32 Line 32 is a subtotal of lines 26 through 30. Mention of *Sîn-rāmā's* sickness serves to qualify the need for a female doctor. What the purpose of *Zinnu* or the pregnant woman is here is uncertain due to the worn reading at the end of line 30. Perhaps it has something to do with *Sîn-rāmā*'s sickness or more likely the female doctor.

AO 08524
CDLI number: P386918
Copy: Jean 1926, no. 103
Edition: Jean 1931: no. 119; Breckwoldt 1994: Part V, 83–85
Collation 15 April 2013

Date formula: *Rīm-Sîn* of Larsa year 50 (1773 BCE), month 03, day xx.

AO 08524, attributed to the *Sîn-rāmā* archive (Appendix 2.CC), marks two grain rations given to two individuals in *Rīm-Sîn* year fifty, totaling 1 *bariga* 3 *ban* 5 *sila* (lines 4, 11). Lines 5 through 7 state 'which *Sîn-rāmā* and *Nammu-tukulti* received as revenue in Ašdubba month 2 day 13, Year 21 Isin' (*Rīm-Sîn* year 50). Also, lines 11 through 18 mark a secondary delivery from this revenue, giving this the appearance of a balanced account. However, since this second transaction is broken, it is not treated here. Note that Line 11 is now almost completely worn away rendering further examination of the account impossible. The statement in line 2 suggests that this account was drawn up by *Sîn-rāmā* or a scribe in his employ.

	Transliteration	**Translation**
	Obv	Obv
1	1(bariga) še	1 *bariga* grain
2	ša$_3$ še-ba *ša* ^{d}Sîn-*ra-ma*	in the grain ration of *Sîn-rāmā*
3	3(ban$_2$) 4(diš) sila$_3$ ša$_3$ še-ba *ša* ^{d}Nammu-*tu-kul$_2$-ti*	3 ban 4 sila among the grain ration of *Nammu-*
4	1(bariga) 3(ban$_2$) 5(diš) sila$_3$ še	1 *bariga* 3 *ban* 5 *sila* grain
5	*ša* ^{d}Sîn-*ra-ma*	which *Sîn-rāmā*
6	*u$_3$* ^{d}Nammu-*tu-kul$_2$-ti*	and *Nammu-tukulti*
7	*na-am-ḫa-ar-ti* iti gu$_4$-si-sa$_2$ u$_4$ ⌜1(u) 3(diš)⌝ kam	the revenue of month 2 day 13
8	ša$_3$ mu ki 2(u) 1(diš) i$_3$-si-in^{ki}	in year 21 of Isin (year *Rīm-Sîn* 50)
9	*ša i-na* aš-dub-ba^{ki}	which in Ašdubba
10	*im-maḫ-ru*	was accepted
	Rev	Rev
11	*li-ib-bi* 1(bariga) 3(ban$_2$) 5(diš) sila$_3$ še *an-ni*	In this 1 *bariga* 3 *ban* 5 *sila* of grain
12	1(bariga) ⌜x(ban$_2$)⌝ [...] še	1 *bariga* X *ban* ... grain
13	*ša i-na* ^{kuš}la$^{?}$-še$_3$	which in a leather sack$^{?}$
14	*ak-nu-*[*ku*]*-ma*	I sealed and
15	⌜^{I} ^{d}Ištar⌝-HI$^{?}$.LAM$^{?}$	*Ištar*-hilam
16	*i-na mu-ši-im*	in the night
17	*u$_2$-ša-bi-la-ak-ki-im*	will bring it to you
18	šu-ti-a *pi-iš-ti-ia*	receipt of *Pištiya*
19	[…]sila$_3$[…]⌜x⌝ […]	[…] sila […]
20	iti sig$_4$-a u$_4$[...]	month 3 day […]
21	mu ki 2(u) 1(diš) i$_3$-si-⌜in^{ki}⌝	Year 21 of Isin (*Rīm-Sîn* year 50)

Ashm 1922-336
CDLI number: P347404
Copy: Dalley 2005: no. 061
Collation, 08 April 2014

Date formula: *Rīm-Sîn* of Larsa year 01 (1822 BCE), month 09, day 19.

Ashm 1922-336 is an expenditure of grain for the purchase of silver of or for *Adâya* the sculptor. It is listed as the property of *Šulpae-nāṣir* and *Ilī-ippalsa* (Appendix 2.K). Provenance is uncertain. Note the 1 to 1 rate given in the proposed equivalency: 3 *ban* grain is offered for 1/2 *gin* silver. Two merchants are brought in for this purchase.

	Transliteration	**Translation**
	Obv	Obv
1	3(ban$_2$) še	3 *ban* grain
2	sa$_{10}$ 1/2 gin$_2$ ku$_3$-babbar	price of 1/2 *gin* silver
3	*ša a-da-a* tibira	of *Adâya*, sculptor
4	ša$_3$ *še-e ša is-sa-ni-qu*	from the grain which was checked
	LoE	LoE
5	nig-šu ^{d}šul-pa-e$_3$-*na-ṣir*	property of *Šulpae-nāṣir*
6	[*i*$_3$]-*li*$_2$-*ip-pal-sa*$_3$	[*I*]*lī-ippalsa*
	Rev	Rev
7	[x x] ⌜dam⌝-gar$_3^{meš}$	[…] merchants
8	iti gan-gan-e$_3$ u$_4$ 1(u) 9(diš)-⌜kam⌝	month 9 day 19
9	mu ^{d}*ri-im*-^{d}Sîn ⌜lugal⌝	Year *Rīm-Sîn* (became) king (*Rīm-Sîn* year 1)

Ashm 1923-311
CDLI number: P347449
Copy: Dalley 2005: no. 106
Collation, 08 April 2014

Date formula: *Hammu-rābi* of Babylon year 32 (1761 BCE), month 03, day 16.

Ashm 1923-311, attributed to scribe O (Appendix 2.FF) of uncertain provenance and active in the grain production archive, is a complex text in which the grain yeilds are probably estimated for a series of fields, both long and regular, while oxen are allocated to this grain production. Line 1 exhibits an interesting deviation from expected sign forms that possibly shows scribe O caught a mistake he had made in expressing value before the text was complete or had dried.

The author probably wrote 8(bur$_3$) 4(aš) a-ša$_3$ and, upon realizing he had omitted GAN$_2$, wrote it quickly between 4(aš) and a-ša$_3$. This shows that, to the author, GAN$_2$ was an important element of the measurement value. The appearance of a-ša$_3$, literally 'field', already made clear that this was a surface measurement value. However, the aš sign, used to account for *iku* measurement values here, was also used to accounting for *gur* capacity measurement values and *gu* weight values as explained in Chap. 2. An entry for '4 *iku*' appears on the metrological lists and tables as '4(aš) GAN$_2$' without accompanying a-ša$_3$ (see Proust 2007: 313 for this

entry). Perhaps GAN$_2$ was not a spoken element of the language to scribe O, but instead was an unspoken determinative. Thus, this corrected mistake could explain what exactly made up a measurement value according to this Old Babylonian scribe and enumerate how they were expressed in an Old Babylonian scribal school. Scribe O learned that a proper written measurement value was made up of an arithmogram, a metrogram, and then a lexeme.[1]

	Transliteration	**Translation**
	Obv	Obv
1	⸢8(bur$_3$)⸣ 4$^{!}$(aš) GAN$_2^{?}$ a-ša$_3$ 3(aš) GAN$_2$ a-ša$_3$ gid$_2$	8 *bur* 4 *iku* field 3 *iku* long field
2	8(bur$_3$) 1(eše$_3$) 1(aš) GAN$_2$ ab-sin$_2$	8 *bur* 1 *eše* 1 *iku* furrows
3	3(geš$_2$) 3(u) 6(aš) 3(bariga) 2(ban$_2$) gur še-bi	3×60+36 *gur* 3 *bariga* 2 *ban* its grain
4	4(bur$_3$) 2(eše$_3$) 4(aš) iku a-ša$_3$ 1(eše$_3$) GAN$_2$ a-ša$_3$gid$_2$	4 *bur* 2 *eše* 4 *iku* field 1 *eše* long field
5	5(bur$_3$) 4(aš) GAN$_2$ ab-sin$_2$	5 *bur* 4 *iku* furrows
6	4(u) 3(aš) 4(bariga) 2(ban$_2$) 6(diš) 5/6 sila$_3$ / še-bi *he-er-ru*	43 *gur* 4 *bariga* 2 *ban* 6 5/6 *sila* / its grain, *ḫ*.-furrows
7	šu-nigin 1(bur'u) 3(bur$_3$) 2(aš) GAN$_2$ a-ša$_3$ / 1(eše$_3$) 3(aš) GAN$_2$ a-ša$_3$ gid$_2$	total 1 *buru* 3 *bur* 2 *iku* fields 1 *eše* 3 *iku* long / field
8	1(bur'u) 3(bur$_3$) 1(eše$_3$) 5(aš) GAN$_2$ ab-sin$_2$	1 *buru* 3 *bur* 1 *eše* 5 *iku* furrowed
9	še-bi 4(geš$_2$) 2(u) 2(bariga) 4(ban$_2$) 6(diš) 5/6 sila$_3$gur	Its grain 4×60+20 *gur* 2 *bariga* 4 *ban* 6 5/6 / *sila*
10	*ša ma-la i-li-a-am ša-ak-nu*	as much as is able is imposed.
11	1(bur$_3$) 2(eše$_3$) 3(aš) 1(ubu) GAN$_2$ a-ša$_3$ 1(ubu) / GAN$_2$ a-ša$_3$ gid$_2$	1 *bur* 2 *eše* 3 *iku* 1 *ubu* fields 1 *ubu* long field
12	1(bur$_3$) 2(eše$_3$) 4(aš) GAN$_2$ ab-sin$_2$	1 *bur* 2 *eše* 4 *iku* furrows
13	3(u) 3(aš) 1(bariga) 4(ban$_2$) še-bi *ḫe-er-ru*	33 *gur* 1 *bariga* 4 *ban* its grain / *ḫ*.-furrow
14	1(bur'u)* 2(bur$_3$) 2(aš) GAN$_2$ a-ša$_3$ 1(bur$_3$) 2(eše$_3$) / 2(aš) GAN$_2$ a-ša$_3$ gid$_2$	1 *bur'u* 2 *bur* 2 *iku* field 1 *bur* 2 *eše* 2 *iku* / long field
15	1(bur'u)* 3(bur$_3$) 2(eše$_3$) 4(aš) GAN$_2$ ab-sin$_2$	1 *bur'u* 3 *bur* 2 *eše* 4 *iku* furrows
16	1(geš$_2$) 1(u) 7(aš) 4(bariga) 4(ban$_2$) 8(diš) / 5/6 sila$_3$ še-bi *ḫe-er-ru*	1×60+17 *gur* 4 *bariga* 4 *ban* 8 5/6 / *sila* its grain, *ḫ*.-furrows
17	[…] 1(bur'u)* 3(bur$_3$) 2(eše$_3$) 5(aš) 1(ubu) GAN$_2$ / a-ša$_3$ 1(bur$_3$) 2(eše$_3$) 2(aš) 1(ubu) GAN$_2$ a-ša$_3$ gid$_2$	1 *bur'u* 3 *bur* 2 *eše* 5 *iku* 1 *ubu iku* field / 1 *bur* 2 *eše* 2 *iku* 1 *ubu iku* long field
18	[…šu-nigin 1(bur'u)]⸢5(bur$_3$) 2(eše$_3$)⸣ 2(aš) GAN$_2$ / ab-sin$_2$	[Total 1 *bur'u*] 5 *bur* 2 *eše* 2 *iku* furrows
19	[…1(geš$_2$) 5(u) 1(aš)]⸢1(bariga) 2(ban$_2$)⸣ 8(diš) 5/6 / sila$_3$	[1×60+51 *gur* 1 *bariga*] 2 *ban* 8 5/6 *sila* gur
20	[…]2/3-ta	[…] per $^{?}$ 2/3
21	[…]1+(ubu) GAN$_2$ a-ša$_3$ gid$_2$	[…] 1 *ubu iku* long field
22	[…ab]⸢-sin$_2$⸣	[…fur]rows
23	[…]⸢x⸣	…

[1]See Proust (2009: Sect. 3.5.4) for the significance of the distinction of aš as a numerical value, GAN$_2$ as a unit of measure and a-ša$_3$ as a lexeme signifying the nature of the quantified item (*ibid.*).

	Rev	Rev
	Broken	Broken
24’	[…]ab⸢-sin$_2$⸣ […]	[…]furrows
25’	[…]⸢4+(diš)⸣ 1/2 sila$_3$ gur se-bi *ḫ e-er-ru*	[…] +4 1/2 *sila gur* its grain *ḫ*-furrow ox
26’	[…]⸢1(ubu)⸣ iku a-ša$_3$ 2(bur$_3$)⸣ 5(aš) 1(ubu) / GAN$_2$ a-ša$_3$ gid$_2$	[…] 1 *ubu* field 2 *bur* 5 *iku* 1 *ubu* long field
27’	⸢4+(bur$_3$)$^?$⸣ 1(eše$_3$) 1(aš) ab-sin$_2$	4+ *bur*$^?$ 1 *eše* 1 *iku* furrows
28’	⸢6(geš$_2$)⸣ 1(u) 1(aš) 4(bariga) 1(ban$_2$) 5(diš) 1/2 / sila$_3$ gur	6$^?$×60+11 *gur* 4 *bariga* 1 *ban* 5 1/2 *sila*
29’	[*ša*$^?$] 1(u) 2(diš) gu$_4$-ḫi-a *ša* ^{d}Šamaš-*ša-ta-ka-lim*	[of] 12 oxen of *Šamaš-ša-takālim*
30’	[…] *u*$_3$ 1(u) 8(diš) gu$_4$-ḫi-a *ša* ^{d}Šamaš-*tu-ra-am*	and 18 oxen of *Šamaš-tūram*
31’	šu-nigin 3(u) gu$_4$-ḫi-a	total 30 oxen
32’	*ša iš-tu* iti ^{giš}apin-du$_8$-a u$_4$ 2(u)-kam	which from month 8 day 20
33’	[…] MU$^?$ e$_2$-gal-*lum id-di-nu-šum-ma*	[…] the palace gave to him and
34’	[…*i*]-*ri-šu-u*$_2$-*ma i-na* iti udru (ZIZ$_2$.A) u$_4$ 2(u)-kam	[…he] will cultivate and in month 11 day 20
35’	*a-na* ^{d}Šamaš-*ša-ta-ka-lim*	to *Šamaš-ša-takālim*
36’	*u*$_3$ ^{d}Šamaš-*tu-ra-am* gu$_4$-ḫi-a *u*$_2$-*te-er-ru*	and *Šamaš-tūram* he will return the / oxen
37’	ensi$_2$-*a-pi-il-i*$_3$-*li*$_2$ ra$_2$-gaba	Ensi-*apil-ilī*, messenger
38’	gu$_2$ i$_7$ ug-gim-du bala-re ki ^{d}Šamaš-e$_3$-a	bank of the uggimdu other side of the place / *Šamaš-ea*
39’	kišib-a-ni ib$_2$-ra	their seals were impressed
40’	iti sig$_4$-a u$_4$ 1(u) 6(diš)-kam	month 3 day 16
41’	mu *ḫa-am-mu-ra-bi* lugal ur-sag	Year *Hammu-rābi* the king, the hero
42’	u$_3$-ma sa$_2$ ^{d}Marduk-ke$_4$	who gains victory for Marduk,
43’	ugnim <eš$_3$->nun-na<^{ki}> ^{giš}tukul kalag-ga-na	with his mighty weapons the army of / Ešnunna
44’	me$_3$-ta bi$_2$-ib-šub-ba	defeated in battle
45’	ma-an-ki-sum$_2$ u$_3$ ma-da gu$_2$ idigna	the land of Mankisum and the land on the / banks of the Tigris
46’	en-na zag kur su-bir$_4^{ki}$-še$_3$ šu-ni sa$_2$ bi$_2$-du$_{11}$-ga	up to the border of the conquered Subartu / mountains (*Hammu-rābi* year 32).

Notes

1 On first inspection line 1 could read ‘8(bur$_3$)’ 6$^?$(aš) 2$^?$(diš) a-ša$_3$ but is more likely an il-formed 8(bur$_3$) 4(aš) GAN$_2$ a-ša$_3$. See above for the production of this anomaly. This corrected value is reflected in the subtotal of line 2.

14 Upon collation the tablet revealed 1(bur’u) 2(bur$_3$) rather than 3(bur$_3$) on the copy.

15, 17 Collation revealed 1(bur’u) 3(bur$_3$) instead of 4(bur$_3$) on the copy.

20 One wonders if this is a description of how harvest is to be divided.

28’ The beginning of this grain total is broken so that the initial value cannot be firmly stated. However, two wedges of a lower part of at least 6(geš$_2$) is apparent. This as well as the rest of the line matches well with the expected total so that it’s likely that the author rounded 2/3 *sila* down by one-6th *sila* to produce 1/2 *sila*.

Ashm 1923-315
CDLI number: P347451
Copy: Dalley 2005: no. 108
Collation, 08 April 2014

No date formula.

Ashm 1923-315, of unknown provenance, belongs possibly to the archive of *Issu-nar*-[…] (Appendix 2.QQ) who is mentioned in line 23. The text itself surrounds various disbursements of mostly grain received by *Issu-nar*-[…]. These disbursements range from an equivalent for silver (lines 1, 2) to perhaps canal excavations (lines 11–13) and maintenance (line 16). The expected total in line 20 is 11 *gur* 2 *bariga* 2 *ban* 5 1/3 *sila*. The author may have rounded off 1/3 *sila*, although the text is broken at the ends of lines 20 and 21. He may also have made a mistake in calculation. This mistake and rounding resulted in an addition of 1 *bariga* 4 *ban* 9 2/3 *sila*, producing a difference of 3.2 per cent.

	Transliteration	**Translation**
	Obv	Obv
1	4(aš) 4(ban$_2$) še-gur	4 *gur* 4 *ban gur* grain
2	*ša* 5(diš) gin$_2$ ku$_3$-babbar	for 5 *gin* silver
3	1(aš) gur *ka-aṣ -ba-* ⸢*tum*$^{?}$⸣	1 *gur* reduced (bread)$^{?}$
4	1(aš) gur *sa$_3$-mu-um*	1 *gur* reddish (grain)$^{?}$
5	1(aš) 2(bariga) 3(ban$_2$) eš$_2$ šuku *ša* u$_4$ 5	1 *gur* 2 *bariga* 3 *ban* flour rations of 5 days
6	3(bariga) 4(ban$_2$) 5(diš) sila$_3$ še *ki-di-num*	3 *bariga* 4 *ban* 5 *sila* grain the protected one$^{?}$
7	2(bariga) 3(ban$_2$) še gi	2 *bariga* 3 *ban* grain reeds
8	2(bariga) še *sa$_3$-ab-su$_2$-um*	2 *bariga* grain, sack maker
9	1(bariga) 4(ban$_2$) *ša i-nu-u$_2$-ma*	1 *bariga* 4 *ban* when
10	*pu-qi$_2$-im*	he was attentive
11	1(bariga) še *ki-in-ku-um* ki 1(diš)	1 *bariga* grain, tag (for) place 1
12	2(ban$_2$) še ⸢ki⸣ 2(diš)	2 *ban* grain place 2
13	1(ban$_2$) še [k]i 3(diš)	1 *ban* grain place 3
14	2(bariga) *gu-gu-«ra»-tum*	2 *bariga gugutum* fodder
15	1(aš) gur *i-de-e le-er$^{?}$-um*	1 *gur* fee of *lerum*
16	1(u) 5(diš) še kun-zi-da$^{!}$(LI^{sic})	15 *gur* grain the weir$^{?}$
17	1(u) 5(diš) še *ša i-nu-u$_2$-ma*	15 *gur* grain which when
	LoE	LoE
18	*pu-qi$_2$-im*	he was attentive
19	*a-na* eden *u$_3$* ku$_6$	to the plain and fish$^{?}$
	Rev	Rev
20	igi 6(diš)-gal$_2$ [...]	one-6th [...]
21	5(ban$_2$) [...]	5 *ban* [...]
22	šu-nigin 1(u) 1(aš) 4(bariga) 1(ban$_2$) 5(diš) / sila$_3$	total 11 *gur* 4 *bariga* 5 *sila*
23	šu-ti-a ⸢is-su⸣-na-ar-⸢x⸣	receipt of *Issu-nar*[…]

Notes

3 *kāṣbātum* is perhaps the feminine plural of *kāṣibum*, 'breaking' (CAD K: 264), or better 'reducing' (Black et al. 2000: 151), and derived from *kaṣābum*, 'to cut off' (CAD K: 257) or 'to reduce, pare off' (Black et al. 2000: 151). Note that both are standard Babylonian, a literary form of the late second and first millennium.

4 Perhaps *sāmum*, 'red, brown' (CAD S, 126–130). See most recently Michel and Veenhof (2010: 252) for *samum*, red, used with Old Assyrian wool and textiles.

6 Perhaps this is *kidinnum*, 'divine protection' (CAD K: 342–344), especially 344 or 'protection, aegis' (Black et al. 2000: 156). It could be used to describe one or many persons under the status of divine protection.

9–10, 17–18 The meaning of these lines is unclear. For *puqqum*, see CAD (P: 512–514) and Black et al. (2000: 278). Perhaps this is referring to the fulfillment of an obligation or demand of the king, or a vow (see entry 1b and then 1a CAD P: 512, 513 for this use).

11 *kinkum* is understood as a variety of tag (CAD K: 387) or sealing (Black et al. 2000: 158) used to mark labor. Thus, this is a record of wages for work done in places (ki) 1, 2, and 3 in lines 11–13.

14 For *gugutum* see Black et al. (2000: 95). However, note CAD (G: 123) where it is either a breed of sheep or a kind of spice.

15 The middle sign in *lirtum* is uncertain. It seems unlikely that this would refer to *lēru*, a mineral coloring (cf. CAD L: 147, 148) or gold paste measured by weight (Black et al. 2000: 180). Perhaps the fee here is that requested by a personal name.

16 The final sign is very uncertain. I am not aware of a word kun-zi-li or even zi-li. Thus, it is interpreted as a mistake for 'da' rendering the word 'weir' for which see Steinkeller (2001: 35, note 46). This is understood as a grain allocation for labor during an excavation or construction of a weir.

Ashm 1924-453
CDLI number: P347490,
Copy: Dalley 2005: no. 147
Collation, 08 April 2014

No date formula.

Ashm 1924-453, probably from the kingdom of Larsa, is an undated text attributed to scribe S (Appendix 2.SS) and of an unknown provenance that presents a list of šuku rations for two consecutive days.

	Transliteration	**Translation**
	Obv	Obv
1	⸢1(ban$_2$)⸣ 5(diš) sila$_3$ šuku	1 *ban* 5 *sila* rations
2	[...]⸢sila$_3$ nagar⸣	[...] *sila* carpenters
3	[...] kurun$_2^{\text{meš}}$	[...] brewers
4	2(diš) sila$_3$ simug⸢$^{\text{meš}}$⸣	2 *sila* metal workers
5	2(ban$_2$) šuku erin$_2$ nig$_2$ *im-gur*-ušu$_3$	2 *ban* rations men, property of *Imgur-Sîn*
6	1(ban$_2$) šuku erin$_2$ nig$_2$ $^{\text{giš}}$mar	1 *ban* rations men, property of the chariots$^?$
7	1(ban$_2$) *na-ap-ta-nu-um*$_2$	1 *ban* meal
8	3(diš)$^?$ sila$_3$ šuku sag-x	3 *sila* rations of x
9	2(diš) sila$_3$ šuku ir$_3$-e$_2$	3 *sila* rations of the household slave
10	2(diš) sila$_3$ e$_2$ $^{\text{d}}$Adad	2 *sila* temple of *Adad*
	LoE	LoE
11	1(diš) 2(u) 1(diš)	1:21
12	u$_4$ 12-kam	day 12
	Rev	Rev
13	2(ban$_2$) 4(diš) sila$_3$ šuku	2 *ban* 4 *sila* rations
14	4(diš) sila$_3$ nagar	4 *sila* carpenters
15	6(diš) sila$_3$ kurun$_2$	6 *sila* brewers
16	simug	metal worker
17	2(ban$_2$) šuku erin$_2$ nig$_2$ *im-gur*-ušu$_3^!$	2 *ban* rations (for) men, property of *Imgur-Sîn*
18	1(ban$_2$) šuku erin$_2$ nig$_2$ $^{\text{giš}}$mar	1 *ban* rations (for) men, property of the chariots$^?$
19	1(ban$_2$) *na-ap-ta-nu-um*$_2$	1 *ban* meal
20	4(diš) sila$_3$ šuku ir$_3$-e$_2$	4 *sila* rations of the household slave
21	2(diš) sila$_3$ e$_2$ $^{\text{d}}$Adad	2 *sila* temple of *Adad*
	UpE	UpE
22	1(diš) 2(u)	1:20
23	u$_4$ 13-kam	day 13

Notes

16 While the beginning is broken, there is no note for sila$_3$ and no traces for any ban$_2$. Indeed, there is no trace of a single wedge when there is enough unbroken area to represent one. This leads one to believe that no amount was present in this line, that is, the metal worker received no rations for day 13. This also fits with the quantity stated in line 22, 1:20. Collation revealed this to be pressed down as if there was an erasure.

AUAM 73.2672
CDLI number: P249591
Copy: Sigrist 1990: no. 074
Edition: Stol 1982: 176 (no. 41, transliteration); Breckwoldt 1994: Part IV, 47

Date formula: *Samsu-iluna* of Babylon year 07 (1743 BCE), month 6, day 22.

AUAM 73.2672, attributed to an actor named *Aḫiya* (Appendix 2.PP) and probably from Larsa, presents a statement of collection and then assessment in silver of dates for a group of individuals' *sūtu*. Thus, it is probably a part of the same system assessing excess crown capital in silver by merchant intermediaries as is described in the Chaps. 3 and 4. An equivalency rate of dates to silver is provided, which helps show how ambiguous these rates can be.

	Transliteration	**Translation**
	Obv	Obv
1	1(u) 8(aš) gur zu$_2$-lum	18 *gur* dates
2	kar-bi 2(aš) gur-ta-am$_3$	its rate 2 *gur* per (*gin*)
3	ku$_3$-bi 9(diš) gin$_2$	its silver 9 *gin*
4	*nam-ḫa-ar-ti*	revenue
5	^{I}*a-ḫi-ia* ugula nam-5	*Aḫiya*, overseer of 5
6	ki *e-tel-pi$_4$* santana	from *Etel-pī*, collector
7	giri$_3$ *a-pil-^{d}ki-it-tum*	transport of *Apil-Kittum*
8	^{I}*u$_2$-ṣi-nu-rum* maš-gag-⸢en⸣	*Uṣī-nūrum, muškenum*
9	*u$_3$ a-ḫu-um*	and *Aḫum*
10	*a-na su$_2$-ti-šu-nu*$^{!}$	as their concession
	Rev	Rev
11	iti kin-^{d}innin u$_4$ 2(u) 2(diš)	month 6, day 22
12	mu *sa-am-su-i-lu-na* lugal	Year *Samsu-iluna* the king (dedicated)
13	^{giš}tukul-šu-nir	a weapon-emblem (*Samsu-iluna* year 7)

	Seal impression:	Seal impression:
1	*im-gur-*^{d}Sîn	*Imgur-Sîn*
2	dumu ^{d}nanna-an-dul$_3$	son of *Sîn-ṣulūlī*
3	ir$_3$ ^{d}nin-šubur	servant of Nin-šubur

Notes

6 The name *Etel-pī* is missing a theophoric element. It's not certain whether this omission is intentional, perhaps a shortening to a common name, or a simple scribal lapse.

10 The end of this line seems to have a distorted 'nu' which Stol took for an additional sign.

LB 1069
CDLI number: P389500
Copy: Leemans 1964: no. 42
Edition: Leemans 1954: no. 41
Collation: 06 March 2014

Date formula: *Rīm-Sîn* of Larsa year 38$^{?}$ (1755 BCE), month 13, day 25.

LB 1069, while part of the same archive as LB 1074 and LB 1078, shows a significant variation and is probably the work of a different scribe (Scribe M, Appendix 2.Z). This is suggested by the similar subject matter as well as the field name in line 11, which is the same field as appears in LB 1078. In LB 1069, the total grain is stated for workers rather than labor rates. Thus, labor is quantified by man-days stated as a number of men, and by total grain expended for these days while labor cost in grain per man is not stated, even though it is implied. In addition, the word for binders, lu$_2$ tu-tab-ba in line 3, is not the same as lu$_2$ *ša-ḫa-ar-rum* present in LB 1074, a further deviation from the other scribe at work in this archive.

	Transliteration	Translation
	Obv	Obv
1	1(u) 9(diš) erin$_2$ lu$_2$ še-kin-ku$_5$	19 men, harvester
2	še-bi 1(aš) 1(bariga) 2(ban$_2$) gur	their grain 1 *gur* 1 *bariga* 2 *ban*
3	1(u) 6(diš) erin$_2$ lu$_2$ tu-tab-ba	16 men, binders
4	še-bi 4(bariga) še	their grain 4 *bariga* grain
5	4(u) 8(diš) erin$_2$ lu$_2$ še-ur$_4$-ur$_4$	48 men, gatherers
6	še-bi 1(aš) 3(bariga) gur	their grain 1 *gur* 3 *bariga*
7	1(geš$_2$) 2(u) 5(diš) erin$_2$ lu$_2$ še-kin-ku$_5$	1×60 + 25 men, harvester
8	še-bi 3(aš) 3(bariga) 2(ban$_2$) gur	their grain 3 *gur* 3 *bariga* 2 *ban*
9	1(bariga) še *ma-aš-ti-tum*	1 *bariga* grain drinks
10	šu-nigin 3(aš) 4(bariga) 2(ban$_2$) gur	total 3 *gur* 3 *bariga* 2 *ban*
11	ša$_3$ še a-ša$_3$ *ḫa-za-za-nu-um*	in the grain of the field of *Hazazanum*
	Rev	Rev
12	iti diri še-kin-ku$_5$ u$_4$ 2(u) 5(diš)-kam	month 13 day 25

Notes

3 The word for binder here, Sumerian lu$_2$ tu-tab-ba, differs from the Akkadian lu$_2$ *ša-ḫa-ar-rum* in LB 1074. With this difference comes a difference in wages: 2 *ban* in LB 1074 and 1 *ban* 5 *sila* here. See note line 2 of LB 1074 for more discussion on this.

5 Note that the word for grain gatherer, lu$_2$ še-ur$_4$-ur$_4$, is the same between this text and LB 1074, while the wage of 1 *ban* per man(-day) is stagnant. See note line 2 of LB 1074 for more on the role of this worker.

LB 1072
CDLI number: P389503
Copy: Leemans 1964: no. 30
Edition: Leemans 1954: no. 30
Collation: 06 March 2014

Date formula: *Rīm-Sîn* of Larsa year 31 (1792 BCE), month 25, day 18.

LB 1072, attributed to scribe J (Appendix 2.W) and perhaps from around Isin, is a household balanced account which enumerates a capital drawn from a sealed store room and then a series of expenditures as well as the balance between the two.

	Transliteration	**Translation**
	Obv	Obv
1	2(bariga) 3(ban$_2$) še ša$_3$ e$_2$ kišib-ba	2 *bariga* 3 *ban* grain in the sealed storeroom
2	sag-nig$_2$-gur$_{11}$ ša-bi-ta	capital out of which
3	3(ban$_2$) šuku e$_2$	3 *ban* rations of the household
4	6(diš) sila$_3$ maš$_2$-ḫi-a	6 *sila* goats
5	5(diš) sila$_3$ gu$_4$	5 *sila* oxen
6	4(ban$_2$) 1 sila$_3$	4 *ban* 1 *sila*
7	šuku e$_2$ ninda u$_4$ 2(diš)-kam	rations of the household, food of day 2
8	⸢zag⸣ iti 2(u) 5(diš) u$_4$ 1(u) 6(diš)-kam en-na u$_4$ / 1(u) 8(diš)-kam	from month 25 day 16 to day 18
9	9(diš) sila$_3$ ninda *a-na* a-ba	9 *sila* food as its wages
10	5(diš) sila$_3$ *ka-su$_2$-u$_2$*	5 *sila* mustard
11	1(diš) sila$_3$ nig$_2$-ar$_3$-ra	1 *sila* groats
12	1(diš) sila$_3$ *sa$_3$-mi-du-um*	1 *sila* the miller
13	5(diš) sila$_3$ ^{gi}*ma-an-sim*	5 *sila* carrying-basket
14	3(diš) sila$_3$ eš-ma-ad-ga$_2^{!}$	3 *sila* m.-flour
15	[...] sila$_3$ a-ba	[...] *sila* its/their wages
16	[...] 1/2 sila$_3$ kaš	[...] 1/2 *sila* beer
17	[...] sila$_3$ lu$_2$ tug$_2$	[...] *sila* weaver
18	1(bariga) 1(ban$_2$) 9 1/2 sila$_3$	1 *bariga* 1 ban 9 1/2 sila
	Rev	Rev
19	⸢ba-zi⸣	disbursed
20	2(bariga) 1/2 sila$_3$ [x] ⸢x⸣	2 *bariga* 1/2 sila…
21	*si-i$_3$-tum* 3(ban$_2$)	balance 3 ban
22	iti 2(u) 5(diš) ki 4(diš) u$_4$ 1(u) 8(diš)-kam	month 25 from 4 day 18
23	mu ki 2(diš) ^{giš}tukul-maḫ An ^{d}en-lil$_2$	year 2 (with) the strong weapon of An (and) Enlil,
24	i$_3$-si-in^{ki} in-dib$_2$-ba	he seized Isin (*Rīm-Sîn* year 31).

Notes

15–17 A total of 5 *ban* 5 *sila* must be distributed across these transactions, in addition to 1/2 *sila* in line 16, for the subtotal in line 18 to be correct.

21 The balance is off 1/2 *sila* from the total, yielding the result shown. 2 *ban* 9 1/2 *sila* is expected instead.

LB 1074
CDLI number: P389505
Copy: Leemans 1964: no. 43
Edition: Leemans 1954: no. 43
Collation: 06 March 2014

Date formula: *Rīm-Sîn* of Larsa year 38 (1785 BCE), month 01, day 29.

LB 1074, attributed to scribe L (Appendix 2.Y), describes cost and wage rates for agricultural activity in the field of *Agakkum*. The exact location of this field is uncertain so that it is difficult to provide a provenance for this text. Similarity to LB 1078 suggest that these texts are related.

When labor in grain for lines 1 through 6 are computed and then added up, there is a difference between what is expected and what is stated of one bariga: 4(aš) 1 (bariga) 5(ban$_2$) is stated rather than the expected 4(aš) 5(ban$_2$). See Chap. 6 for this mistake and Chap. 8 for wage calculation in this text.

	Transliteration	**Translation**
	Obv	Obv
1	4(u) 3(diš) erin$_2$ *ša* 2(ban$_2$)-ta-am$_3$	43 men of 2 *ban* per (man)
2	lu$_2$ *ša-ḫa-ar-rum*	binders
3	3(u) 2(diš) *ša* 1(ban$_2$)-ta-am$_3$	32 of 1 *ban* per (man)
4	lu$_2$ še-ur$_4$-ur$_4$	grain gatherers
5	5(diš) erin$_2$ lu$_2$ *ra-pi-su*	5 men threshers
6	2(diš) lu$_2$ *ma-aš-ka-na-tim u$_2$-dam-mi-qu*	2 people who put the threshing floors in order
7	1(ges$_2$) 2(u) 2(diš) lu$_2$-ḫ un-ga$_2$	1×60+22 laborers
8	še-bi ⌜4(aš)*⌝ 1(bariga) 5(ban$_2$) gur	their grain 4 *gur* 1 *bariga* 5 *ban*
9	lu$_2$ *na-si$_2$-i-ku*	grain pilers
10	1(bariga) 4(ban$_2$) a$_2$-bi 5 erin$_2$ lu$_2$-ḫun-ga$_2$	1 *bariga* 4 *ban* their wages, 5 men, laborers
11	*ša* ^{gi}nun-me-šum *iš-šu-nim*	who carried building reeds
12	1(ban$_2$) 4(diš) sila$_3$ 7(diš) aga-uš-e-ne	1 *ban* 4 *sila*, 7 *rēdû*
13	1(ban$_2$) 5(diš) erin$_2$ *eb-bu-tum*	1 *ban* 5 men craft and labor comptroller
14	6 sila$_3$ 3(diš)* erin$_2$ *mu-za-az* e$_2$	6 *sila*, 3 men, house servants
15	5(ban$_2$) 2(u) 5(diš) erin$_2$ ša$_3$-gu$_4$^{meš}	5 *ban*, 25 men, ox drivers
16	3(bariga) še ba-zi	3 *bariga* grain disbursed
17	x […] zi-x-ak	…
	Rev	Rev
18	šu-nigin 4(aš) 4(bariga) 5(ban$_2$) gur	total 4 *gur* 4 *bariga* 5 *ban*
19	ša$_3$ še a-ša$_3$ *a-ga-ak-kum*	in the grain of the field of *Agakkum*
20	ki 2(diš)	place 2
21	iti bara$_2$-zag-gar u$_4$ 2(u) 9(diš)-kam	month 1 day 29
22	mu ki 9(diš) us$_2$-sa i$_3$-si-in-na	Year 9 after Isin (*Rīm-Sîn* year 39)

Notes

2 Leemans associates lu$_2$ *ša ḫa-ar-rum* here with lu$_2$ tu-tab-ba in LB 1069: 3. He related that the activities of this individual are to carry out ‘some harvesting activity between the cutting of corn and the gathering’ (Leemans 1954: 60, note 3). Thus, Leemans translates it ‘binders’ (*ibid.*: 63). According to the CAD (Š 1: 81), the term *šaḫarrum* designates ‘an agricultural worker using a net for transporting barley’ while it is described as ‘a net for carrying straw, barley’ and the individual using this net by Black et al. (2000: 346). Perhaps the term describes those who bind the harvested grain in the *šaḫarrum*-net to be carried to the threshing floor. Because of the similar position to lu$_2$ tu-tab-ba in LB 1069, Leeman’s understanding of this term is followed, that is, it is translated ‘binders’ noting this nuance. Thus, grain is harvested by the lu$_2$ še-kin-ku$_5$, bound in *šaḫarrum*-nets by the lu$_2$ *ša-ḫa-ar-rum*/lu$_2$ tu-tab-ba, and then gathered and carried to the threshing floor by the lu$_2$ še-ur$_4$-ur$_4$.

8 A broken 4(aš) is found on the tablet as opposed to 3(aš) in Leemans transliteration and translation. The grain total in this line is off by 1 *bariga* from the expected total.

9 Connection with *nāsiku* is very tentatively suggested by Leemans (1954: 62) when discussing LB 1078. This is followed by CAD (N II: 27) where it is stated:

> The word seems to be an active participle, and the exceptional plene writing *na-sí-i-ku* may reflect a known scribal habit peculiar to texts from larsa. The context suggests an agricultural occupation, for which cf. *nasāku* A mng. 1D-l'.

nāsiku is understood here as the participle of *nasākum*, 'to pile up barley [grain] on the threshing floor' (CAD N II: 18) and thus can perhaps be translated as 'he who piles up grain on the threshing floor' or shortened to 'grain piler'. Note that Black et al. (2000: 243) translates *nāsiqum* or *nāsikum* as 'an agricultural worker' and relates it to *nasāqum*, translated 'to choose, select' said of objects, animals, or words (*ibid.*: 243). If this were the case, then these could be the workers who choose grain on the threshing floor, that is, those who separate cereal grain from chaff. In any event, the reference is to agricultural workers who harvest grain and prepare it for consumption.

14 The tablet shows possibly 3 men, against the copy which shows 2 men. Michel translates *eb-bu-tum* 'prud'homme', summing this role up as follows:

> l'ebbum est non seulement un spécialiste du domaine dans lequel il intervient, mais en outre, ses qualifications le mènent à effectuer des calculs d'estimations. Il ne rend pas compte de ses résultats en cours de justice, mais il prête serment comme tout individu appelé à la barre de nos jours; il rend des comptes à l'autorité supérieure, généralement le roi, qui est le représentant de la justice dans le pays (Michel 1990: 213).

While there is no direct cognate, indeed the closest English translation seems to be 'industrial tribunal', it is translated here as 'craft and labor comptroller' noting the deficiencies this translation holds.

20 ki 2(diš) is written in a large boxed off area on the tablet, clearly separated from the rest of the text.

LB 1078
CDLI number: P389509
Copy: Leemans 1964: no. 42
Edition: Leemans 1954: no. 42
Collation: 06 March 2014

Date formula: *Rīm-Sîn* of Larsa year 38$^?$ (1785), month 02, day 09$^?$.

LB 1078, related to LB 1074 and attributed to scribe L (Appendix 2.Y), reports the costs of agricultural activity and rates of wages in the field of *Hazazanum*.

	Transliteration	**Translation**
	Obv	Obv
1	8(diš) erin$_2$ *ša* 1(ban$_2$) 2(diš) sila$_3$-ta-am	8 men of 1 *ban* 2 *sila* per (man)
2	1(u) 2(diš) erin$_2$ *ša* 4(diš) sila$_3$-ta-am$_3$	12 *men* of 4 *sila* per (man)
3	2(u) erin$_2$ še-a	20 men for grain
4	še-bi 2(bariga) 2(ban$_2$) 4(diš) sila$_3$ še	their grain 2 *bariga* 2 *ban* 4 *sila* grain
5	lu$_2$ *e-di-ḫu*	basket menders?
6	1(diš) erin$_2$ *ša* 1(ban$_2$) 2(diš) sila$_3$-ta-am$_3$	1 man of 1 *ban* 2 *sila* per (man)
7	1(diš) erin$_2$ še-bi 1(ban$_2$) 2(diš) sila$_3$ še	1 man his grain 1 *ban* 2 *sila*
8	lu$_2$ *ra-pi-su$_2$-um*	thresher
9	9(diš) erin$_2$ *ša* 1(ban$_2$) 2(diš) sila$_3$-ta-am$_3$	9 men of 1 *ban* 2 *sila* per (man)
10	1(u) 2(diš) erin$_2$ *ša* 4(diš) sila$_3$-ta-am$_3$	12 men of 4 *sila* per (man)
11	še-bi 2(bariga) 3(ban$_2$) 6(diš) sila$_3$ še	their grain 2 *bariga* 3 *ban* 6 *sila* grain
	Rev	Rev
12	lu$_2$ *na-si$_2$-ku*	grain pilers
13	3(ban$_2$) 9(diš) sila$_3$ še duḫ-bi ša$_3$-gal gu$_4$-ḫi-a	3 *ban* 9 *sila* grain its bran, fodder for oxen
14	4(ban$_2$) 4(diš) sila$_3$ 2(u) 2(diš) erin$_2$ ša$_3$-gu$_4$	4 *ban* 4 *sila*, 22 men ox drivers
15	1(ban$_2$) 4(diš) sila$_3$ 7(diš) erin$_2$ *eb-bu-tum*	1 *ban* 4 *sila*, 7 men craft and labor comptroller
16	1(ban$_2$) 5(diš) erin$_2$ aga-uš-e-ne	1 *ban* 5 men *rēdû*
17	4(diš) sila$_3$ 2(diš) erin$_2$ *mu-uz$_x$-za-az* e$_2$	4 *sila*, 2 men house servant
18	2(diš) sila$_3$ 1(diš) nagar	2 *sila*, 1 carpenter
19	2(diš) sila$_3$ 1(diš) erin$_2$ lu$_2$-ḫun-ga	2 *sila*, 1 man, hired hands
20	1(bariga) 5(ban$_2$) 5(diš) sila$_3$ še	1 *bariga* 5 *ban* 5 *sila* grain
21	*ma-aš-ti-tum u$_3$* ša$_3$-gal gu$_4$-ḫi-a	drinks and ox fodder
22	šu-nigin 4(bariga) 3(ban$_2$) 1(diš) sila$_3$ še ki / 6(diš)	total 4 *bariga* 3 *ban* 1 *sila* grain from / 6th
23	ša$_3$ še a-ša$_3$ *ḫa-za-za-nu-um*	in the grain of the field of *Hazazanum*
24	iti gu$_4$-si-sa$_2$ u$_4$ 9(diš)-kam	month 2 day 9

Notes

5 *ēdiḫu* follows CAD (E: 31) and Black et al. (2000: 66) rather than Leemans (1954: 61, 62) where it is transliterated *e-su-ḫu* and translated binders. Leemans' suggestion requires a connection to the verb *esēḫu* which is otherwise unattested; it is usually connected to 'destiny'. CAD (E: 25) connects this word to the verb *edēḫu* and states of this use 'The profession nam *ēdiḫu* (also *ēdiku*), appearing in connection with terms for harvest workers, should therefore designate a person as a mender of baskets or as one who reinforces old baskets by means of a network of reed ropes'. *Edēḫu* is often used in 'reference to colored spots, threads (GU.MEŠ), veins (*šerānū*), and stalks of the *kasû*-plant' (*ibid.*: 25).

12 For *nāsiku*, see LB 1074, line 9.

15 See LB 1074, note line 14 above.

LB 1091
CDLI number: P389522
Copy: Leemans 1964: no. 47
Edition: Leemans 1954: no. 47
Collation: 06 March 2014

Date formula: *Rīm-Sîn* of Larsa (1822-1763 BCE), no year, month 04, day 26.

LB 1091, attributed to scribe D (Appendix 2.F), is a list that can be described as a day account recording household costs. Leemans suggests that this text records quantities of flour for baking in lines 1–9 and then wages in the rest of the text. Provenance is uncertain, although the name *Rīm-Sîn-ilī* in line 17 tentatively suggests proximity to the city of Larsa and the reign of *Rīm-Sîn*.

	Obv	Obv
1	1(bariga) ⸢zi$_3$⸣-[gu]⸢ki⸣ 1(diš) *a-na e-pe-e-em*	1 *bariga* flour in the 1st place for baking
2	3(ban$_2$) 6(diš) sila$_3$ zi$_3$-gu ki 2(diš) *a-na e-pe-e-em*	3 *ban* 6 *sila* flour in the 2nd place for baking
3	3(diš) sila$_3$ zi$_3$-gu ki 3(diš) *a-na e-pe-e-em*	3 *sila* flour in the 3rd place for baking
4	1(ban$_2$) 7(diš) sila$_3$ zi$_3$-ma-gaz$^?$	1 *ban* 7 *sila* ground flour
5	6(diš) sila$_3$ sumun$_2$-e	6 *sila* beer mash (vessel)$^?$
6	1(diš) sila$_3$ *a-na ši-ka-tim*	1 *sila* for a flask$^?$
7	1(diš) sila$_3$ *a-na bu-ur-tim*	1 *sila* for the *burtum*-vessel
8	1(diš) sila$_3$ *a-na e-pi-tum*	1 *sila* for the female baker
9	2(bariga) 5(diš) sila$_3$	2 *bariga* 5 *sila*
10	1(diš) sila$_3$ *ta-ri-bu-um*	1 *sila Tarībum*
11	1(diš) 1/2 sila$_3$ *pu-ḫa-bi-li*	1 1/2 *sila Pūḫabili*
12	1(diš) 1/2 sila$_3$ ^{d}Adad-*ri-ma-an-ni*	1 1/2 *sila Adad-rimanni*
13	1(diš)* sila$_3$ *gi-mil-*^{d}Šamaš	1 *sila Gimil-Šamaš*
14	1(diš)* sila$_3$ ^{d}Sîn-*ri-ma-an-ni*	1 *sila Sîn-rimanni*
15	1(diš)* sila$_3$ ^{d}nanna-ma-an-si	1 *sila Sîn-iddinam*
16	1(diš) 1/2 sila$_3$ ^{d}Sîn-*ni-šu*	1 1/2 *sila Sîn-nišū*
17	1(diš) 1/2 sila$_3$ *ri-im-*^{d}Sîn-*i$_3$-li$_2$*	1 1/2 *sila Rīm-Sîn-ilī*
18	1(diš) sila$_3$ ^{d}Sîn-*tu-ra-am*	1 *sila Sîn-turram*
19	1(diš) sila$_3$ *i$_3$-li$_2$-i-din-nam*	1 *sila Ilī-iddinam*
	LoE	LoE
20	1(u)* 5(u)* 6(diš)*	10$^?$ 56
	Rev	Rev
21	1(diš) sila$_3$ *ši-ri-a-a-bi*	1 *sila Širia-abi*
22	1(diš) 1/2 sila$_3$ *it-ti-*^{d}Sîn-*ba-la-ṣu*	1 1/2 *sila Itti-Sîn-balāṣu*
23	1(diš) sila$_3$ *ḫu-za-a-lum*	1 *sila Ḫuzālum*
24	1(diš) sila$_3$ *ḫu-zu-mu-um*	1 *sila Ḫuzzumum*
25	1(diš) sila$_3$ *a-na-*^{d}Šamaš-*tak$_2$-la-ku*	1 *sila Ana-Šamaš-taklāku*
26	1(diš) sila$_3$ *a-na-*^{d}Sîn-*tak$_2$-la-ku*	1 *sila Ana-Sîn-taklāku*
27	2/3* sila$_3$ *šum-ma-an-la-*^{d}Ištar	2/3 *sila Šumman-lā-Ištar*
28	2/3* sila$_3$ *ki-nu-um-ḫa-bi-il*	2/3 *sila Kīnum-ḫabil*
29	*li-bur-ṣi-li$_2$*	*Lībūr-ṣillī*
30	2/3* sila$_3$	2/3 *sila*
31	1(diš) sila$_3$ ^{d}Sîn-*ra-bi*	1 *sila Sîn-rabi*
32	1(diš) sila$_3$ *ṣi-li$_2$-*^{d}Ištar	1 *sila Ṣillī-Ištar*
33	1(diš) sila$_3$ *i-ri-ba-am-*^{d}Sîn	1 *sila Irībam-Sîn*
34	2(ban$_2$) 3(diš) 1/2 sila$_3$	2 *ban* 3 1/2 *sila*
35	šu-nigin 2(bariga) 2(ban$_2$) (diš)8 1/2 sila$_3$	total 2 *bariga* 2 *ban* 8 1/2 *sila*
36	iti šu-numun-a u$_4$ 2(u) 6(diš)-kam	month 4 day 26

Notes

7 Leemans, citing a private conversation with Von Soden, states that *būrtum* here may be an otherwise unattested feminine form of *būrum.*

8 Leemans (1954: 73) transliterates *e-pe-tum*, *epētum*, translates this item as a baker's trough and suggests a connection with *epû*, 'to bake'. This connection with baking is likely, although the nature of the term used here is uncertain. CAD (E: 248) shows a feminine form of *epû*, 'baker', as *ēpītum* and suggests 'woman bakers' and 'makers of sweets'. Black et al. (2000: 76) also suggest 'female baker' but offers another meaning, when normalized as *epītum*, of 'baked product'. However, note the context of lines 1–8 suggests that this entire section refers to the production of baked goods. Since no baker is mentioned prior to this entry, it seems possible that this entry would refer to the baker herself.

13–15 Collation of the tablet reveals 1/2 $sila_3$ is missing, against Leemans. Indeed, these three lines would seem to offer erasures where 1/2 was, if anything.

20 According to Leemans, the Lower Edge holds line 20, which has 1(bariga) 1 (ban_2) še 9 $sila_3$. However, collation revealed line 20 lacks 1(bariga) 1(ban_2) and instead shows partial-SPVN 10 56, as well as evidence for an erasure and prior number written underneath. It is no surprise at this creative reading since Leemans (1954: 71, note 24) admits the numbers in the text confused him.

23 Note an additional mark on the text which leads to the possibility of 2(diš) $sila_3$ here, although this seems unlikely. There is no visible head to the marking and every entry around it seems to denote 1(diš) or 1/2 only.

27–30 Collation reveals these lines refer to either 2/3, not 1(diš) or 1(diš) 1/2. 2/3 $sila_3$ works well with the stated amount.

LB 1092
CDLI number: P389523
Leemans 1964: no. 61
Edition: Leemans 1954: no. 61
Collation: 06 March 2014

Date formula: *Warad-Sîn* or *Rīm-Sîn* of Larsa? (1834-1763 BCE), month –, day –.

LB 1092, attributed to scribe C (Appendix 2.E) and of unknown provenance, states a series of silver expenditures for grain, seed, and other, broken transactions. The total is written in SPVN rather than a measurement value.

	Transliteration	Translation
	Obv	Obv
1	[5/6] ma-na sa$_{10}$ 1(geš$_2$) gur še	[5/6] *mana* price of 1×60 *gur* grain
2 3	2/3 ma-na 9(diš) gin$_2$ igi 6(diš)-gal$_2$ sa$_{10}$ še-numun-a šu-ti-a ^{d}Sîn-*ma*-dingir	2/3 *mana* 9 *gin* one-6th price of seed-grain receipt of *Sîn-ma-ilī*
4	1/2 ma-na šu-ti-a *mu-na-ni*	1/2 *mana* receipt of *Munani*
5	1(u) gin$_2$ sa$_{10}$ še *ta-ri-ba-tum*	10 *gin* price of grain, *Tarībatum*
6 7	1(u) 2(diš) gin$_2$ šu-ti-a ^{d}Sîn-*ma*-dingir *i-nu-ma a-na* […]^{ki} *il-li-ku*	12 *gin* receipt of *Sîn-ma-ili* when he went to […]
8	1(u) 9(diš) gin$_2$ […]	19 *gin* […]
9	1(u) gin$_2$ *bi*-[…]	10 *gin* […]
10	6(diš) gin$_2$ *ḫa*-[…]	6 *gin* […]
11	1(u) 3(diš) gin$_2$ *ga*-[…]	13 *gin* […]
12	1/2 ma-na 7(diš) gin$_2$ […] x	1/2 *mana* 7 *gin* […]
13	3(diš) 5(u) 6(diš)* 1(u)	3:56:10
	LoE	LoE
	Erasure	Erasure

Notes

1 The restoration of 5/6 ma-na is based on the number at the bottom of the text. This notation requires the number 50, the transformation of 5/6 *mana*, to work. The size of the break allows this understanding. Leemans, unable to understand the notation at the bottom of the text, suggests 1 *mana* based on what he understands as a standard price of barley.

13 Against the copy in Leemans 1964 collation revealed what appears to be two additional diš at the bottom of this number is possibly a downward tilted gash rendering this number possibly 6(diš) rather than 8(diš) in the notation. This works well with the calculation where one expects 56 and not 58.

LoE Collation revealed an erasure on the lower edge.

LB 1097
CDLI number: P389528
Copy: Leemans 1964: no. 46
Edition: Leemans 1954: no. 46; Stol 1994: 233–235
Collation: 06 March 2014

No date formula.

LB 1097 is attributed here to scribe T (Appendix 2.TT). It is quite clear from his translation and remarks on the text that Leemans was unable to develop a full understanding of the nature and content of this tablet. This text was taken up again by Stol in 1994 with an attempt to produce an arithmetic interpretation for the text. Stol's attempt was really quite visionary. He deserves credit for understanding the importance of mathematical practice to the interpretation of economic texts.

Provenance for this text is uncertain but Leemans places it securely in Southern Babylonia and suggests Umma as a possible place of origin based on its appearance in the text alone. Note that this is the only name in the entire text. Additionally, it is stated by Leemans that this text differs slightly in orthography and shape from Larsa texts. The lack of names or date within the text, as well as the proposed example of rate estimations to define the expenditures leads one to believe this text was written as an internal document meant to assist the writer in administering the preparations of a large field for planting.

	Transliteration	**Translation**
	Obv	Obv
1	4*(aš) 2(bariga) 2(ban$_2$) gur a-ša$_3$ *ša-ka-ku*	4 *gur* 2 *bariga* 2 *ban* field to harrow
2	2(aš) 2(bariga) 2(ban$_2$) gur a-ša$_3$ *še$_{20}$-be-rum*	2 *gur* 2 *bariga* 2 *ban* field to break
3	*ša* 3 iku *iš-ku-ku* 1(bariga) še *i-ku-⸢lu⸣*	for 3 *iku* they harrowed, 1 *bariga* grain they ate
4	5*(aš) 1(bariga) 1(ban$_2$) 5(diš) sila$_3$ gur a-ša$_3$ ab-sin$_2$	5 *gur* 1 *bariga* 1 *ban* 5 *sila* furrowed field
5	*ša* 1(bur$_3$) iku a-ša$_3$ 7(diš) *i-ri-ša$^{!}$-ma* 1(bariga)-ta / *⸢i-ku-lu⸣*	for 1 *bur iku* field 7 they plow 1 *bariga* per / (*bur*) they ate
6	4(aš) 1(bariga) 5(ban$_2$) 2(diš) 1/2 sila$_3$ gur ⸢še⸣- / numun	4 *gur* 1 *bariga* 5 *ban* 2 1/2 *sila* seeds
7	*ša* 1(bur$_3$) iku a-ša$_3$ 1(aš) 1(bariga) 4(ban$_2$) *ik-šu-dam*	of which 1 *bur iku* field, 1 *gur* 1 *bariga* 4 *ban* / is sown
8	4(aš) 2(bariga) 2(ban$_2$) gur *ša* 1(bur$_3$) 2(eše$_3$) 1 iku / *ša-ak-ki u$_3$ še$_{20}$-eb-ri*	4 *gur* 2 *bariga* 2 *ban* of which 1 *bur* 2 *eše* 1 *iku* / harrowed and broken
9	*ša* 3(aš) 1(ubu) iku a-ša$_3$ *ši-ik-ka-tim la še$_{20}$-eb-ri$^{!}$-ti*	of which 3 *iku* 1 *ubu* is harrowed but not broken
10	*iš-tu* 1 (bur$_3$) 4(aš) 1(ubu) iku *ši-ik-ka-at ša-am-mi*	out of 1 *bur* 4 *iku* 1 *ubu* grass harrowed
11	*na-as-ḫa*	is removed
12	*ša* 3(aš) iku a-ša$_3$ *iš-ku-ku-ma* 1(bariga) še *i-ku-lu*	of which 3 *iku* field they harrow 1 *bariga* grain / they eat
13	4(bariga) še *ša* 4(aš) iku a-ša$_3$ *ma-a-a-ru*	4 *bariga* grain for a 4 *iku* deep plowed field
14	*ša* 1(aš) iku *im-ḫa-ṣ u$_2$-ma* 1(bariga) še *i-ku-lu*	for 1 iku they plowed, 1 *bariga* grain they ate
	LoE	LoE
15	2(u) 3(aš) 4(bariga) 7 1/2 sila$_3$	23 *gur* 4 *bariga* 7 1/2 *sila*
	Rev	Rev
16	še-numun *u$_3$* ša$_3$-gal	seed and fodder
17	3(aš) 2(bariga) gur a-ša$_3$ *ka*-[x]-*⸢zi⸣*	3 *gur* 2 *bariga* x-field
18	[…] ad$^{?}$ […]	…
19	[…]⸢3$^{?}$(ban$_2$)⸣* 6(diš) sila$_3$ ša$_3$-gal gu$_4$-ḫi-a *ša* / *ta-ab-li-tum*	[…] 3 *ban*$^{?}$ 6 *sila* oxen fodder which is / sustenance
20	nig$_2$-gu$_7$ u$_4$ 6(diš)-kam	feed 6 days
21	4(ban$_2$) na-gada gu$_4$-ḫi-a *i-nu-ma a-na* um-ma^{ki}	4 *ban* the cattle herdsman when to Umma
22	*is-su$_2$-ḫu-ni-im*	they took away
23	1(bariga) 5(ban$_2$) 2(diš) 1/2 sila$_3$ *la*-[*qa$_2$-at*] *ki-ir-ba-* / *ni-im*	1 *bariga* 5 *ban* 2 1/2 *sila* to gather lumps (of / earth)
24	2(u) 8*(diš) 4(diš) 3(u) 5(diš)	28:4:35

Notes

1 Upon collation, it is suggested that only 4(aš) gur was originally written on this line, against Stol's suggestion of 5(aš) gur and Leemans 6(aš) gur. Although there is a small break before this quantity, this break is clearly outside of the text.

Moreover, there is no trace of one or two additional *gur* while this small break allows for traces of additional wedges to occur.

1–3 These lines describe a two-step process to begin preparing a field. The rate in line 3 applies only to the quantity in line 1 because the statement in line 3 is a harrowing rate 3 *gur* for 1 *bariga*. That is, it is the rate for harrowing only, not harrowing and breaking.

4 The tablet shows 5(aš), not 6(aš).

7 This line is much worn and thus the quantities involved are very tentative. Stol's suggestion of 1(aš) 1(bariga) 5(ban_2) is not followed. Collation of the tablet revealed that this mark does not match the shape of wedges seen in similar positions, such as that marking 5(ban_2) in line 6, but instead displays characteristics of a scratch or hole produced while the clay was drying. However, the reader should be aware that the scratch on the tablet covers enough space for that extra winkelhaken and allows for the possibility of 5(ban_2). See Stol (1994: 234) where it is stated:

> The 5 *bán* instead of Leemans' 4 is perfectly clear on the tablet and even on the photograph. Calculations do not yield a nice round figure per *iku* (22,777 … litres).

Stol is describing a ratio of 22.777 *sila* per one *iku* using modern base 10 if this is to be read as 5(ban_2), against a ratio of 22.222 *sila* per one *iku* if this is to be read as 4(ban_2). This amounts to 22 7/9 or 22 2/9 respectively. This assumes the rate was defined by *sila* per *iku*, which is unclear.

4(ban_2) makes much sense if line 7 refers to a rate in SPVN: 1 *gur* 1 *bariga* 4 *ban* transforms to 6:40 in SPVN, which has a reciprocal of 9. 1 *gur* 1 *bariga* 5 *ban* transforms to 6:50 in SPVN and is non-regular, i.e. it has no reciprocal. Thus, 1 *gur* 1 *bariga* 5 *ban* could not be used in division without approximation and for this reason was difficult to use as part of a rate. This synthesis assumes calculation was carried out in SPVN after transformation.

7, 8 A one-line space occurs between these lines.

8–12 This possibly implies that the grain in line 8 is consumed in working all the fields of lines 8–13 and the areas represented in this section refer to a description of the field. The total of lines 8 through 12 should be 3 *bur* 3 *iku*. However, lines 13–14 should probably be added to this description. It is separated in the text because an additional process is required in working it, namely deep plowing, which required extra grain in addition to what is expended here for consumption.

10 Stol places this line before 9 in his transliteration, which neither the Leemans 1954 image nor collation support. This must be a simple mistake, whether his or in publishing.

15 The total here, if line 1 is correctly read, is off by 2 *gur*. One expects 21 *gur* 4 *bariga* 7 1/2 *sila*.

18, 19 These lines must have presented 1 *gur* 5 *ban* between them for the amount represented in the marginal notation below this section to be correct.

19 Collation revealed possible 3(ban_2) before 6(diš) $sila_3$.

24 Marginal notation: collation revealed two additional faint wedges rendering 2(u) 8(diš) rather than 2(u) 6(diš).

LB 2053
CDLI number: P390337
Copy: Leemans 1964: no. 45
Edition: Leemans 1954: no. 45
Collation: 06 March 2014

Date: *Rīm-Sîn* of Larsa year 34? (1789 BCE), month –, day –.

LB 2053, attributed to scribe K (Appendix 2.X) of uncertain provenance, as well as LB 1098, describe expenditures of bran as fodder (lines 2–12) for a listed number of plow teams (13–15). The purpose of these expenditures, as stated in line 11 of this text, is harrowing and leveling. Unfortunately, the last lines of LB 2035 are broken so date and any other details are unknown. Leemans suggests *Rīm-Sîn* year 34.

	Transliteration Obv	**Translation** Obv
1	iti 2 […]	month 2…
2	5(ban_2) še *ša* 3(ban_2) duḫ-ta	5 *ban* grain of 3 *ban* bran per (sila)
3	1(aš) 2(bariga) 1(ban_2) 3(diš) $sila_3$ *ša* u_4 / 1(u) 7(diš)-kam	1 *gur* 2 *bariga* 1 *ban* 3 *sila* which is of 17 days
4	5(ban_2) še *ša* 3(ban_2) duḫ-ta	5 *ban* grain of 3 *ban* bran per (sila)
5	4?(aš) 2(bariga) 3(ban_2) 7(diš) $sila_3$ *ša* u_4 / 2(u) 3(diš)-kam	4 *gur* 2 *bariga* 3 *ban* 7 *sila* which is of 23 days
6	4(ban_2) še *ša* 2(ban_2) duḫ-ta	4 *ban* grain of 2 *ban* bran per (sila)
7	3(aš) 2 (ban_2) gur *ša* u_4 2(u)-kam	3 *gur* 2 *ban* which is of 20 days
8	4(ban_2) še *ša* 2(ban_2) duḫ-ta	4 *ban* grain of 2 *ban* bran per (sila)
9	4(bariga) 5(ban_2) gur *ša* u_4 5(diš)-kam / *ma-ra-ga-an-x*	4 *bariga* 5 *ban gur* which is of 5 days …
10	1(u) gur duḫ	10 *gur* bran

11	x *ša-ka-ki-im u*$_3$ *še*$_{20}$*-be*$_2$*-ri-im*	x to harrow and break
12	*ša* iti 2*(diš)-kam *u*$_3$ u$_4$ 5(diš)-kam	which is of 2 months and of 5 days
	Rev	Rev
13	3(diš) *i-ni-a-tum* ir$_3$-[…]	3 cattle, *Warad*-[…]
14	1(diš) e$_2$-*ra*-[*bi*]	1 *Bīt-rabi*
15	4(diš)$^?$ šu-^{d}ba-[ba$_6$]	4 *Šu-Baba*
	Rest broken	Rest broken

Notes

3 The writing of 2 *bariga* is odd, two diš signs are written next to each other which would appear to offer the possible reading of 3 or 4 *bariga*.

5 Collation suggests possibly reading 2(u) 4(diš) rather than 2(u) 3(diš).

12 Collation revealed iti 2(diš)-kam, not iti 3(diš)-kam as shown in the copy. Leemans notes that this is the total of dates on the text so that this may be a simple typo and not a mistake in interpretation: He understood this was a total of days and makes no note of deviation in this total.

LB 3051
CDLI number: P390118
Copy: Leemans 1964: no. 68
Edition: Leemans 1954: no. 68
Collation: 07 March 2014

Date formula: *Rīm-Sîn* of Larsa year 59 (1764 BCE), month 10, day 28.

LB 3051, attributed here to *Aḫūšunu* (Appendix 2.EE) but of uncertain provenance, lists disbursements for various purposes, including boat fees, wages, and irrigation. The disbursed property, stated as the property of *Aḫūšunu*, is said to be given from the deficit.

	Transliteration	**Translation**
	Obv	Obv
1	⸢1(u) 3*(aš)⸣ gur sag-‹nig$_2$›-gur$_{11}$-ra ša$_3$-bi-ta	13$^?$ *gur* capital, out of which
2	2(bariga) 4(ban$_2$) 5(diš) sila$_3$ a$_2$-bi ^{giš}ma$_2$ *ma-*⸢*ti*⸣	2 *bariga* 4 *ban* 5 *sila* its wages, boat, *Mati*
3	u$_3$ ⸢*šu*⸣*-ta* x	and *Šuta* x
4	5(ban$_2$) *a-ḫu-šu-nu*	5 *ban Aḫūšunu*
5	5(diš) gin$_2$ lu$_2$ še-il$_2$	5 *gin* grain porters
6	3(bariga) 5(ban$_2$) 5(diš) sila$_3$ ba-zi	3 *bariga* 5 *ban* 5 *sila* disbursed
7	3(aš) gur dingir-*lam-ki-i*	3 *gur Ilamkî*
8	4(bariga) *mu-ḫa-ad-du-um*	4 *bariga Muḫaddûm*
9	5(aš) gur *a-bi-a-a-am-ši*	5 *gur Abī-Ayya-amši*
10	*u*$_3$ *a-pil-er*$_3$*-ra*	and *Apil-Erra*
11	1(diš) gin$_2$ ku$_3$-babbar *a-pil-er*$_3$*-ra*	1 *gin* silver, *Apil-Erra*
12	2(bariga) *ša-ma-a-a-tum*	2 *bariga Šamayyatum*

13	2(bariga) *nu-ur*$_2$-^{d}Šamaš	2 *bariga Nūr-Šamaš*
14	2(bariga) *a-wi-il*-dingir	2 *bariga Awīl-ilī*
	Rev	Rev
15	1(bariga) *ap-lum*	1 *bariga Aplum*
16	1(bariga) 4(ban$_2$) dingir-*lam-ki-i*	1 *bariga* 4 *ban Ilamkî*
17	*a-na me-e ša-*⸢*qi*$_2$⸣*-im*	toward water to irrigate
18	4(bariga) šuku ir$_3$-^{d}Amurru	4 *bariga* rations *Warad-Amurru*
19	zag iti udru (ZIZ$_2$.A) u$_4$ 1(diš) en-na iti bara$_2$ u$_4$ / 2(u) kam	from month 11 day 1 until month 1 day 20
20	2(bariga) ^{d}Sîn-*ip-ṭu*$_2$*-ra*	2 *bariga Sîn-ipṭura*
21	1(bariga) 4(ban$_2$) *a-bi-a-a-am-ši*	1 *bariga* 4 *ban Abī-Ayya-amši*
22	*a-na me-e*! *ša-*⸢*qi*$_2$⸣*-im*	toward water to irrigate
23	1(bariga) 5(ban$_2$) *a-ḫu-šu-nu*	1 *bariga* 5 *ban Aḫūšunu*
24	1(ban$_2$) a$_2$-bi e$_2$	1 *ban* its fee, house
25	1(u) 3(aš) 1(bariga) 1(ban$_2$) gur 5(diš) / sila$_3$ še	13 *gur* 1 *bariga* 1 *ban* 5 *sila* grain
26	1(diš) gin$_2$ ku$_3$-babbar	1 *gin* silver
27	nig$_2$-šu *a-ḫu-šu-nu*	property, *Aḫūšunu*
28	*ša i-na* im-ba *in-na-ad-/nu*	which was given from the deficit
29	iti ab-e$_3$ u$_4$ 2(u) 8(diš) kam	Month 10 day 28
30	mu ki 3(u)	Year 30 (*Rīm-Sîn* year 59)

Notes

1 Collation shows 3(aš) and not 4(aš) as witnessed by the copy.

2 Leemans notes the possibility of an additional sign: '*ma*-x-*ti*(?)'.

17, 22 Leemans (1954: 97) notes qi$_2$ is uncertain here, 'although it does not seem to have the appearance of *ki*, it may be assumed that the word is *ša-qí-im*, this yielding a well-known expression for the watering of a field…'.

28 Leemans suggests '-dul' instead of '-ba' rendering the word 'im-dul', Akkadian *dullu*, 'work', and translating the passage 'which have been given at the work (?)'. However, note that CAD (I: 109), under the verb *imbû* B, 'loss, deficit', states this *imbû* is a loan word from Sumerian im-ba attested in the phrase ku$_3$ im-ba.

NBC 05474
CDLI number: P292922
Copy: Alexander 1943: no. 153
Edition: Walters 1970: 129
Collation: 18 December 2013

Date formula: *Sūmû-el* of Larsa year 16 (1879 BCE), month 07, day –.

NBC 05474 of the *Lu-igisa* archive (Appendix 2.B) and perhaps from around Larsa, lists disbursements of bricks to various individuals, possibly overseers in constructing a brick wall at the top of the weir in the mouth of the Isin canal, as stated in lines 9 and 10.

	Transliteration	**Translation**
	Obv	Obv
1	1(u) 2(diš) sar sig$_4$ *im-gur-*^{d}Sîn	12 *sar* bricks *Imgur-Sîn*
2	6(diš) sar *šu-*^{d}*na-zi*	6 *sar Šu-Nazi*
3	3(diš) 1/3 sar *bu-ru-um*	3 1/3 *sar Būrum*
4	2(diš) sar ^{d}Sîn-*iš-me-a-ni*	2 *sar Sîn-išmeanni*
5	4(diš) sar ^{d}Nanna-ki-ag$_2$	4 *sar Nanna-kiag*
6	1(diš) 1/2 sar *na-ra-a-a*	1 *sar Nāraya*
7	1(u) 9(diš) sar *nu-ur*$_2$*-i*$_3$*-li*$_2$*-a*	19 *sar Nūr-ilīšu*
8	4(u) 7(diš) 2/3 sar	47 2/3 *sar*
	Rev	Rev
9	ig$_4$ bad$_3$ ugu kun-zi-da	bricks, wall on top of the weir
10	ka i$_7$ i$_3$-si-in^{ki}	mouth of the Isin canal
11	iti du$_6$-ku$_3$	month 7
12	mu e$_2$-duru$_5$ i$_3$-sa$_3$^{ki} ba-an-dib$_2$	Year *Sūmû-el* seized the town of (Nanna-)iša / (*Sūmû-el* year 16)

NBC 06339
CDLI number: P286528
Copy: Walters 1970: no. 44
Edition: Walters 1970: 127, 128
Collation: 18 December 2013

Date formula: *Sūmû-el* of Larsa year 16 (1879 BCE), month 7, day 02.

NBC 06339 belongs to the *Lu-igisa* archive (Appendix 2.B) presented by Walters in his 1970 monograph and is possibly from around the city of Larsa. It probably lists work teams and their work assignments. Each entry states a number of bricks first, followed by workers, both of which are qualified by a supervisor.

	Transliteration	**Translation**
	Obv	Obv
1	2(diš) sar 4(diš) erin$_2$ 7(diš) *a-ta-a-a*	2 *sar* 4 men 7 *Atta-ayya*
2	3(diš) 2/3 sar erin$_2$ 1(u) 3(diš) ur-^{d}asar-lu-ḫi	3 2/3 *sar* men 13 *Ur-Asarluḫi*
3	*u*$_3$ *sa*$_3$*-ak-ni-ia*	and *Sakniya*
4	1(diš) 1/2 sar erin$_2$ 6(diš) erin$_2$ *a-bi-e-ra-aḫ*	1 1/2 *sar* men 6 men *Abī-eraḫ*
5	*u*$_3$ *ip-qu*$_2$*-iš*$_8$*-tar*$_2$	and *Ipqu-Ištar*
6	2(diš) 2/3 sar erin$_2$ 7(diš) *a-wi-li-ia*	2 2/3 *sar* men 7 *Awīliya*
7	*u*$_3$ *u*$_2$*-ta-a-a*	and *Uta-ayya*
8	6(diš) sar erin$_2$ 2(u) 1(diš) *nu-ur*$_2$*-ra-ṭum*	6 *sar* men 21 *Nūr-râṭum*
9	1(diš) sar erin$_2$ 2(diš) *a-ta-na-a-a*	1 *sar* men 2 *Attana-ayya*
10	2(diš) ˹sar˺ erin$_2$ 6(diš) ˹*ku-uk*˺*-ku-lum*	2 *sar* 6 men *Kukkulum*
11	2(diš) 1/2 sar erin$_2$ 7(diš)* *ḫu-nu-bu-um*	2 1/2 *sar* men 7 *Ḫunnubum*
12	2(diš) sar 3(diš) erin$_2$ 6(diš) *sa*$_3$*-si*$_2$*-ia*	2 *sar* 3 men 6 *Sasiya*
	Rev	Rev
13	3(diš) sar erin$_2$ 1(u) lugal-ibila	3 *sar* men 10 *Lugal-ibila*
14	1(diš) 5/6 sar *nu-ur*$_2$-^{d}Sîn	1 5/6 *sar* men *Nūr-Sîn*
15	˹erin$_2$˺ 6(diš) ur-^{d}šu-bu-la	men 6 *Ur-šubula*
16	5/6 sar erin$_2$ 3(diš) *bur*$^{!}$-˹*ri-ia*˺	5/6 *sar* men 3 *Burria*
17	2(u) 9(diš) sar sig$_4$	29 *sar* bricks
18	1(geš$_2$) 2(u) 5(diš) erin$_2$-ḫi-a	1×60+25 men
19	kun-zi i$_7$ i$_3$-si-in^{ki}	Barrage of the Isin canal
20	iti du$_6$-ku$_3$ u$_4$ 2(diš)-kam ba-zal	Month 7, day 2
21	mu e$_2$-duru$_5$ i$_3$-sa$_3$^{ki} ba-an-dib$_2$	Year the town of Nanna-iša was seized (*Sūmû-el* / year 16)

Notes

11 ‘erin$_2$ 7(diš)’ is visible on the tablet, against 6(dis) in the copy.

NBC 08014
CDLI number: P299461
Copy: Simmons 1978: no. 290
Collation: 12 November 2013

Date formula: *Sîn-iddinam* of Larsa year 06 (1844 BCE), month 11, day 15.

NBC 08014, attributed to *Ilšu-ibbišu* (Appendix 2.D), describes an equivalency made between silver and a value of gold. The silver value was received by the text’s main actor, *Ilšu-ibbišu* for the purchase of gold. Location is very tentatively suggested as Larsa, perhaps the author is even working in the goldsmith’s workshop at the Ebabbar temple as described in Chap. 7, or the text is recording activity in *Maškan-šapir*, based on the element *Emutbalim* in the personal name of line 5.

	Transliteration	**Translation**
	Obv	Obv
1	⸢1/2⸣ ma-na 6(diš) 1/2 gin$_2$ ku$_3$-babbar	1/2 *mana* 6 1/2 *gin* silver
2	sa$_{10}$ 3(diš) 2/3 gin$_2$ ku$_3$-gi	price of 3 2/3 *gin* gold
3	ganba-a 1(u) gin$_2$-ta-am$_3$	going rate is 10 *gin* per (*gin* gold)
4	šu-ti-a dingir-*šu-i-bi-šu*	receipt of *Ilšu-ibbišu*
	Rev	Rev
5	giri$_3$ *su-mu-e-mu-ut-ba-lim*	transport of *Sūmû-Emutbalim*
6	^{I}*na-bi-i$_3$-li$_2$-šu*	*Nabi-ilīšu*
7	$^{I\,d}$Šamaš-palil	*Šamaš-ašarēdu*
8	$^{I\,d}$Adad-sipa	*Adad-rē’î*
9	$^{I\,d}$nanna-ma-an-/si$_3$	*Sîn-mansûm*
10	^{I}ušu$_3$-*ṣi-nu-šu*	*Sîn-ṣinušu*
11	*u$_3$* ša$_3$-tam^{meš}	and the *šatammu* officials
	UpE	UpE
12	iti udru (ZIZ$_2$.A) u$_4$ 1(u) 5(diš)-kam	month 11, day 15
13	[mu-ma]-da *eš$_3$-nun-na*	Year the land of Ešnunna (*Sîn-iddinam* year 6)

YBC 04224
CDLI number: P305520
Copy: Simmons 1978: no. 164
Edition: Breckwoldt 1994: Part V, 178, 179
Collation: 12 November 2013

No date formula, *Gungunum* of Larsa$^?$ (1932-1906 BCE).

YBC 04224, was probably produced during the reign of *Gungunum* of Larsa who ruled from about 1932 to 1906 BCE. The text on YBC 04224 is a balanced account as described in Chap. 3, in which both capital and expenditures in silver or silver equivalents are listed, as well as the difference between these two sections, i.e. the balance. Interestingly, this balance is then distributed to various merchants. Line 38 suggests the actor who produced this text, listed as scribe A here (Appendix 2.A), may have been the merchant overseer of an unstated town or one of his

representatives. However, references to towns near Larsa suggest this overseer may be located in or near Larsa.[2] As merchant overseer, the actor would have been responsible for, among other things, the kingdom's excess capital produced by or allotted to the city in which he was active. Capital, found in lines 1 through 13, takes the form of wool, sesame, butter, cheese and dates which is then assessed in silver probably by the recipients of this capital in lines 1–10. Line 30, 'various disbursements of the palace', makes explicit that the silver represented by this text is palace property, which shows that the merchant overseer is acting as a representative of the palace. Moreover, the silver of this text as witnessed in the expenditures section (lines 14 through 34) goes to official purposes such as Amorite troops in lines 16 through 19, as well as a census in line 20. Excess silver is not left to sit but distributed to various merchants for investments in lines 35 through 51.

	Transliteration	**Translation**
	Obv	Obv
1	4(aš) gu$_2$ 4(u) 1(diš) 1/2 ma-na 5(diš) gin$_2$ 1(u) 5(diš) / še ku$_3$-babbar	4 *gu* 41 1/2 *mana* 5 *gin* 15 *še* silver
2	sa$_{10}$ siki še-giš-i$_3$ i$_3$-nun ga-ar$_3$ zu$_2$-⸢lum⸣/-ma	price of wool, sesame, butter, cheese, dates
3	šu-ti-a *ip-qu$_2$-ša*	receipt of *Ipquša*
4	4(aš)gu$_2$4 (u)1/2 ma-na 6(diš) ⸢2/3*⸣ gin$_2$ 4(diš) še	4 *gu* 40 1/2 *mana* 6 2/3 *gin* 4 *še*
5	sa$_{10}$ siki še-giš-i$_3$ i$_3$-nun ga-ar$_3$ zu$_2$-<lum>	price of wool, sesame, butter, cheese, dates
6	šu-ti-a *li-pi$_2$-it-er$_3$-ra*	receipt of *Lipit-Erra*
7	2(u) 7(diš) ma-na 1(u) 1(diš) gin$_2$ 1(u) [7(diš)] še	27 *mana* 11 *gin* 1[7] *še*
8	lu$_2$ bad$_3$-tibira$^{\text{ki.meš}}$	the men of Bād-tibira
9	9(aš) gu$_2$ 4(u) 9(diš) 2/3 ma-na 2(diš) 1/2 / gin$_2$ 6(diš) še	9 *gu* 49 2/3 *mana* 2 1/2 *gin* 6 *še*
10	sag il$_2$-la-bi 1(u) 9(diš) 1/2 ma-na 8(diš) 2/3 gin$_2$ / 1(u) 5(diš) še	(difference) when assessed 19 1/2 *mana* 8 2/3 / *gin* 15 *še*
11	šu-nigin 1(u)gu$_2$ 9(diš) ma-na[1(diš)]gin$_2$ igi 4(diš)- / gal$_2$ 6(diš) [še]	total 10 *gu* 9 *mana* [1] *gin* one-4$^{\text{th}}$ 6 [*še*]
12	sag-⸢nig$_2$⸣-gur$_{11}$-ra-am ša$_3$-bi[-ta]	capital out of which
13	8(diš) gu$_2$ 1(u) ma-na ku$_3$-babbar na$_4$-dam-gar	8 *gu* 10 *mana* silver (according to the) merchant / weight
14	mu-ku$_x$(DU) e$_2$-gal-še$_3$	delivered to the palace
15	5(u) 6(aš) 1(bariga) 4(ban$_2$) še-giš-i$_3$ nig$_2$-šu ensi$_2^{\text{meš}}$	56 *gur* 1 *bariga* 4 *ban* sesame property of the / farmers
16	2(u) 6(aš) 1(bariga) 3(ban$_2$) 5(diš) sila$_3$ gur erin$_2$ / Amurru	26 *gur* 1 *bariga* 3 *ban* 5 *sila gur* Amorite troops
17	uru$^{\text{ki}}$ *me-du-u-um*	*Al-Medûm*
18	2(u) 1(aš) 3(bariga) 3(ban$_2$) 2(diš) sila$_3$ gur erin$_2$ / Amurru	21*gur* 3 *bariga* 3 *ban* 2 *sila gur* Amorite troops
19	uru$^{\text{ki}}$ *di-la-a-nu-um*	*Al-Dilānum*
20	3(u) 1(aš) 5(ban$_2$) gur eš$_2$-gar$_3$ *te-bi-ib-tum*	31 *gur* 5 *ban* work assignment of census
	LoE	LoE
21	*ša* a-na gar-gar ša$_3$-tam-e-ne	which the addition of the *šatammu*
22	*im-ṭu$_2$-u*	lowers.
23	giri$_3$ giri$_3$-i$_3$-sa$_6$ *u$_3$* tab-ba-ni$^{\text{meš}}$	transport of *Šēp-isa* and associates

[2] *Bād-tibira*, *al-Medum*, *al-Dilanum*, and *al-Raḫabum* in lines 8 and 34, 17, 19 and 43 respectively.

	Rev	Rev
24	2(geš$_2$) 1(u) 5(aš) 2(bariga) 3(ban$_2$) 7(diš) / sila$_3$ gur	2×60+15 *gur* 2 *bariga* 3 *ban* 7 *sila*
25	sag il$_2$-la-bi 4(aš) 2(bariga) 3(ban$_2$) gur	(difference) when assessed 4 *gur* 2 / *bariga* 3 *ban*
26	šu-nigin 2(geš$_2$) 2(u) gur še-giš-i$_3$	total 2×60+20 *gur* sesame
27	kar-bi 5(ban$_2$)-ta ku$_3$-bi 1(u) 4(diš) ma-na	its fixed rate 5 *ban* per (*gin* silver), its silver / 14 *mana*
28	zi zi ⸢bi$_2$$^{?}$⸣ lugal	… of the king
29	3(diš) ma-na 1(u) 1(diš) 2/3 gin$_2$ 1(u) 8(diš) še	3 *mana* 11 2/3 *gin* 18 *še*
30	kišib ib$_2$-ra⸢-ḫi-a zi⸣-ga e$_2$-gal	various sealings, disbursement of the palace
31	7(aš) gu$_2$ 2(u) ⸢7(diš)⸣ ma-na	7 *gu* 27 *mana*
32	1(u) 1(diš) 2/3 [gin$_2$1(u) 8(diš)] še	11 2/3 [*gin* 18] *še*
33	mu-ku$_x$(DU) ⸢*ip-qu$_2$-ša*⸣ *li-pi$_2$-*⸢*it-er$_3$-ra*⸣	delivery of *Ipquša, Lipit-Erra*
34	*u$_3$* lu$_2$ bad$_3$-tibira$^{ki.meš}$	and the men of *Bād-tibira*
35	*si-i$_3$-tum* 1(diš) gu$_2$ 4(u) 1(diš) 2/3 ma-na	balance 1 *gu* 41 2/3 *mana*
36	9(diš) 1/3 gin$_2$ ⸢3(diš)*⸣ še	9 1/3 *gin* 3 *še*
37	na$_4$-dam-gar$_3$	(according to the) merchant weight
38	ki ugula-dam-gar-e-ne i$_3$-gal$_2$	available from the merchant overseer
39	3(u) 8 (diš) 2/3 ma-na 2(diš) 5/6 gin$_2$ 1(u) 8(diš) še	38 2/3 *mana* 2 5/6 *gin* 18 *še*
40	na$_4$-dam-gar$_3$ giri$_3$ *i-pi$_2$-iq-^{d}da-gan*	merchant weight, transport of *Ipiq-Dagan*
41	3(u) 5(aš) gur še-giš-i$_3$ ku$_3$-bi 5(diš) 1/2 ma-na	35 *gur* sesame its silver 5 1/2 *mana*
42	2(u) ^{giš}ba-an 1(u) na$_4$-lugal	20 *ban*-standard vessel 10 royal weight
43	ur-^{d}nin-a-zu uru^{ki} *ra-ḫa-bu-um*	Ur-Ninazu of *Al-Raḫabum*
44	3(u) 2/3 ma-na 2(diš) 2/3 gin$_2$ 1(u) 5(diš) še	30 2/3 *mana* 2 2/3 *gin* 15 *še*
45	na$_4$-dam-gar$_3$	(according to the) merchant weight
	UpE	UpE
46	$^{I\,d}$Sîn-ereš$_4$	*Sîn-errēš*
47	1(diš) 2/3 ma-na na$_4$-dam-gar$_3$	1 2/3 *mana* (according to the) merchant weight
48	*nu-ur$_2$-^{d}a-ba*	*Nūr-aba*
	LeE	LeE
49	2(u) ma-na 1(u) 5(diš) gin$_2$ na$_4$-dam-gar$_3$	20 *mana* 15 *gin* (according to the) merchant / weight
50	ki ^{d}Sîn-*mu-ba-li$_2$-iṭ*	from *Sîn-muballiṭ*
51	nam-ga-eš$_8$	travelling merchant

Notes

4 Simmons appears to have seen a worn 2/3 symbol indicated in the copy and which collation confirms. This fits the total in line 9.

7 The break in the text allows a reading of 7(diš) making the value 17 *še*. Although this is not certain, it would lead to the total in line 9.

8, 34 For this city, located near Larsa, see Groneberg (1980: 36).

11 There are traces of 1(diš) which fits the total well.

17 For *al-Medûm*, see Groneberg (1980: 167) where proximity to Larsa is tentatively suggested.

19 For *al-Dilānum*, see Groneberg (1980: 51). Mention of *al-Medûm* and *al-Raḫabum* in the same text suggests this city is located near Larsa.

21, 22 This term is employed to state a reduction in an expected quantity because of an 'addition', '*ša a-na* gar-gar $ša_3$-tam-e-ne/*im-ṭu*$_2$*-u*' 'which the addition of the *šatammu* / lowers'. CAD (M 1: 429) translates 'to be short a given quantity, decrease in number, to become smaller' while Black et al. (2000: 205) translate it 'of yield, possessions etc. "become less, lessen, diminish"', both of which support the use in YBC 04224. Høyrup (2002: 59) notes this verb employed in mathematical texts to imply a subtractive procedure which invoked a comparison, 'how much B falls short of A' (*ibid.*: 21). However, the use of the word 'gar-gar', 'addition', would seem to oppose both the statement that this is a reduction and that this implies a subtraction. This is reconciled by who is carrying out this 'addition', the *šatammu* officials who may have reevaluated outgoing goods and thus, in comparing the original measured value with this official's reevaluated value, would have noted and subtracted the difference from the original statement. This solution would then support both the CAD definition as well as Høyrup's definition. It might be suggested that the reevaluation is a sample measurement and subsequent change rate calculation, which is similar to that described in Sect. 7.1.3.

26 7(diš) $sila_3$ is clearly rounded off the expected total to arrive at a round number.

31, 32 One expects 8(aš) gu_2 instead of 7(aš). The break gives plenty of room for an extra diš.

35, 36 One expects 1/2 gin_2 instead of 1/3 gin_2 on the tablet. The break allows for 3 (diš) še against the copy's 2(u). Collation is ambiguous on this point. However, when the total grain and total disbursements are considered, it becomes clear that 3(diš) was meant. Yet, one must remain aware that this may be 2(u) here. This would be a further discrepancy, although intent would then be uncertain.

43 For *al-Raḫabum*, see Groneberg (1980: 194). See also Thureau-Dangin (1924: 25, note 2) where proximity to Larsa is suggested as well as Leemans (1976: 218, 219) where proximity to *Zabalum* is suggested.

YBC 04265
CDLI number: P305557
Copy: Stol 1982: no. 29
Edition: Stol 1982: 171; Chambon and Marti 2017: 71–73

Date formula: *Hammu-rābi* of Babylon year 36 (1757 BCE), month 04, day 04.

YBC 04265, attributed to *Nabi-Šamaš* B (Appendix 2.HH), is possibly from Larsa. The text appears as a contract in which *Nabi-Šamaš* entrusts a quantity of grain to a bearer. Two conversion rates estimate how the quantity in line 1, the expected value upon delivery, will convert from the quantity in line 7 which is

entrusted to the bearer for delivery. This is probably not a loan contract because the rates are far too low (a rate of 1/9). If it were a loan one would expect to find an interest rate of 1/3 for grain, or 1/5 for silver (see Middeke-Conlin and Proust 2014: Sect. 6, Number 1).

Chambon and Marti (2017: 73) suggest that this text may describe a shipment of grain and its associated customs tax based on proximity between the rate of 1/9 in this text and the customs tax rate of 1/10 at Mari as well as the appearance of the verb *târum*. For the assessment of taxes, see Sect. 8.1. While this is an interesting and plausible understanding, it poses some difficulties. First, it must be noted that 1/9 is different from the tax rates suggested in Chap. 8 (see discussion of AO 08493 where a rate is 1/5). Moreover, this would be a new use of *târum* in the Old Babylonian period in southern Mesopotamia. The CAD (T: 264 8d 1') notes in the Old Assyrian period a few possible examples of this verb associated with taxes, but in the Old Babylonian period and in southern Mesopotamia, *târum* only refers to a return, such as a kind of interest (see *ibid.*: 264 8d 2'). A value added is instead found with the verb *waṣābum*, 'to add', as seen in LB 1075 where a sample remeasurement is described. Finally, this is not qualified as a tax—no assessing administration is described, such as 'the king' in AO 08493, or even a verb that qualifies an official assessment like 'sag-bi$_2$ la$_2$' in LB 1075, nor is it qualified by a kind of tax such as *miksu* which is common to both Mari and the kingdom of Larsa as a kind of duty or customs tax,[3] nor is the proposed tax itself stated, 5 *ban* 8 1/3 *sila*, as it is in AO 08493. At least one of these is necessary to consider this a tax. Instead, the value in line 1 is qualified by the word '*bariga*-standard vessel' and then a conversion rate and '1 *ban*-standard vessel' after another rate, which implies that the standard vessel at disbursement is different from the standard vessel at delivery. Only the converted value is stated in line 7 as a means to qualify the value in line 1.

Thus, it is unlikely that this is a tax or duty, nor is it an interest rate, but instead an estimated standard conversion based on a sample measurement, for which see Sect. 7.1.3 here. YBC 04265 is understood here as a kind of certificate limiting the sender's liability when shipping grain on behalf of the crown after *Hammu-rābi* took control of the kingdom. Perhaps we can hypothesize that this represents a conveyor's perspective in a bureau similar to the grain storage bureau. YBC 04265 would then show that, by the time of the reign of *Hammu-rābi* of Babylon, the grain storage bureau that existed in the reign of *Warad-Sîn* and early in the reign of *Rīm-Sîn* had been replaced by the system in which merchants, members of the local *kārum*, act as intermediaries assessing and in this case managing excess capital or grain owned or controlled by the crown.

[3] Cf. CAD (M 2: 65, 2) and Stol (2004: 747–776, especially 764–766).

	Transliteration	Translation
	Obv	Obv
1	1(geš$_2$) 4(u) 5(aš) gur še	1×60+45 *gur* grain
2	^{giš}ba-ri$_2$-ga	*bariga*-standard vessel (is)
3	1(bariga) 6(diš) 2/3 sila$_3$	1 *bariga* 6 2/3 *sila*
4	*ša i-na* 1(aš) gur 3(ban$_2$) 3(diš) ⸢1/3 sila$_3$⸣	which from 1 *gur*, 3 *ban* 3 1/3 *sila*
5	*a-na* ^{giš}ba-an-1(ban$_2$) ⸢x x⸣	at the 1 *ban*-standard vessel x x
6	*tu-ur-ma*	returns and
7	1(geš$_2$) 5(u) ⸢6(aš)^{sic} 3(bariga)⸣2(ban$_2$) gur še	1×60+56^{sic} *gur* 3 *bariga* 2 *ban* grain
8	*ba-ab-bi-lu-ut* ^{I}mu-⸢na*-wi*-rum*⸣	service as bearer, *Munawwirum*
9	ki *na-bi*-^{d}Šamaš	from *Nabi-Šamaš*
	Rev	Rev
10	igi *šu-nu-u*$_2$*-ma*-dingir	before *Šunuma-ilum*
11	igi *a-bu-lu-mu-ur*	before *Abu-lūmur*
12	igi ^{d}Adad-⸢ereš$_4$*⸣	before *Adad- errēš*
13	igi *i-bi*-e$_2$-a	before *Ibbi-Ea*
14	igi aš-šum-e$_2$-a-ga-am*-x[…]	before *Aššum-Ea-gam*[…]
15	kišib-a-ni ib$_2$-ra	their seals were impressed
16	iti šu-numun-a u$_4$ 4 kam	month 4, day, 4
17	mu e$_2$ me-te-ur-sag	Year the temple of Meteursag (*Hammu-rābi* year 36)
	Seal impression:	Seal impression:
1	^{d}Šamaš*-mu$^{?}$*-x-x (x)	*Šamaš-mu…*
2	dumu *ṣi-li*-^{d}Amurru*	son of *Ṣillī-Amurru*
3	ir$_3$* An* ^{d}Amur[ru]*	Servant of An (and) Amur[ru]

Notes

5 Chambon and Marti read ‘^{giš}*ba-an*-3(ban$_2$) ^{d}[amar-utu]’. However, they only transcribe 3(ban$_2$) because 3(ban$_2$) is used in other texts. Stol’s original copy and transliteration is followed here because a lapse seems unlikely when the author has gone through such pains to show the standard conversions.

7 Stol reads 5(aš) rather than expected 6(aš). Chambon and Marti read 6(aš) following a correspondence with A. Jacquet. However, this section is worn and thus reading is tentative.

8 The reading ^{I}*mu-*⸢*na-wi-rum*⸣ follows Chambon and Marti.

12 Chambon and Marti read ‘ereš$_4$ in the break following Jacquet’s Archibab collation.

14 Chambon and Marti read ‘*aš-šum*-e$_2$-a-*ga-am-r*[*a-ku*] following A. Jacquet’s Archibab suggestion.

Seal impression, 1–3 Following Chambon and Marti who note A. Jacquet’s Archibab collation.

YBC 05494
CDLI number: P306566
Copy: Grice 1919: no. 168
Edition: Breckwoldt 1994: Part V, 147, 148
Collation: 12 November 2013; Breckwoldt 1994: Part V, 147, 148

Date formula: *Rīm-Sîn* of Larsa year 06 (1817 BCE), month 03, day 29.

This balanced account from Larsa, the author of which is uncertain (see Appendix 2.N), marks the delivery of grain to the sealed storeroom of the new house of the broad street (line 6) as well as the costs of transportation including boat fees and drinks. The author clearly rounded 6 *sila* up to 1 *ban* in the difference. The difference between the rounded and expected value in line 12 is 4 *sila* which amounts to a 0.11 per cent increase over the expected value.

	Transliteration	**Translation**
	Obv	Obv
1	[9(geš$_2$)] 3(u) še-gur	[9×60]+30 gur grain
2	⸢ša$_3$⸣ uru^{ki} KA-AN⸢ ^{ki}⸣	in *al*-KA.AN
3	9(geš$_2$) 3(u) gur	9×60+30 *gur*
4	sag-nig$_2$-gur$_{11}$-ra ša-bi-ta	capital, out of which
5	8(geš$_2$) 5(u) 6(aš) 2(bariga) 5(ban$_2$) gur	8×60+56 *gur* 2 *bariga* 5 *ban*
6	mu-ku$_x$(DU) e$_2$ kišib-ba e$_2$ sila dagal-la gibil	delivered to the sealed storeroom of the new / broad street house
7	1(u) 6(aš) 1(bariga) gur a$_2$ ma$_2$-ḫi-a	16 *gur* 1 *bariga* various boat fees
8	[1(aš)]⸢3(bariga)⸣2(ban$_2$) 5(diš)* sila$_3$ gur ⸢*ma*⸣ / [*-aš-ti-tum*]	[1 *gur*] 3 *bariga* 2 *ban* 5 *sila* dr[inks]
9	⸢3(aš) 3(bariga)⸣3(ban$_2$)⸢9(diš)⸣sila$_3$ gur ⸢a$_2$ / lu$_2$ še-il$_2$⸣	3 *gur* 3 *bariga* 3 *ban* 9 *sila* wages grain porters
10	9(geš$_2$) 1(u) 8(aš) 5(ban$_2$) 1[+3(diš) sila$_3$ gur]	9×60+18 *gur* 5 *ban* 1[+3 *sila*]
11	mu-ku$_x$(DU) *u*$_3$ ⸢ba-zi⸣	delivered and disbursed
12	la’u$_4$ 1(u) 1(aš) 4(bariga) 1(ban$_2$)	arrears 11 *gur* 4 *bariga* 1 *ban*
13	giri$_3$ dingir-*šu-ba-*[*ni*]	transport of *Ilšu-bani*
	Rev	Rev
14	^{I} *gi-mi-lum*	*Gimillum*
15	^{I} ^{d}nanna-ma-an-si$_3$	*Sîn-iddinam*
16	^{I} *u-bar-rum*	*Ubarrûm*
17	^{I} *im-gur-*^{d}Sîn	*Imgur-Sîn*
18	*u*$_3$ *im-gur-*^{d}Sîn	and *Imgur-Sîn*
19	iti sig$_4$-a u$_4$ 2(u) 9(diš)-kam	month 3 day 29
20	mu e$_2$ ^{d}bara-ul-e-gar-ra	year the temple of *Baraulegarra*
21	ša$_3$ Adab^{ki} mu-un-du$_3$-a	in Adab was built
22	*u*$_3$ alam ku$_3$-gi ^{d}Sîn-*i-din-nam*	and a gold statue of *Sîn-iddinam*,
23	lugal larsa^{ki} mu-un-dim$_2$-ma	king of Larsa, he built (*Rīm-Sîn* year 6)

Notes

2 For uru^{ki} ka-an see Groneberg (1980: 127) and Breckwoldt (1995/1996: 68). Breckwoldt states that this town is mentioned along with Anzagar-Balamunamḫe and Širimtum.

8 It is clear upon reviewing the tablet that 5(diš) is meant, against Breckwoldt (1994: Part V, 168, 169).

9 It is clear from the copy and tablet that the traces of 9(diš) sila$_3$ is written rather than 6(diš) sila$_3$.

YBC 05586
CDLI number: P306653
Copy: Grice 1919: no. 166
Edition: Breckwoldt 1994: Part V, 145, 146
Collation: Breckwoldt 1994: Part V, 145, 146

Date formula: *Warad-Sîn* of Larsa year 4a (1831 BCE), month 04, day 10.

YBC 05586 describes three separate expenditures of capital, as transportation and deliveries to the Šamaš temple grain silo and receipts by *Gimillum*. Interestingly, in the totals section (lines 41–47) labor and transportation costs are not mentioned. This text probably belongs to the grain storage bureau described in Sect. 4.1. and probably comes from Larsa itself. It was probably compiled by *Gimillum* or a scribe in his employ (Appendix 2.G) out of several receipts. If so, this could mean *Gimillum* was based in Larsa as well.

A difference is noted in the text itself, a discrepancy between the third capital disbursement and expenditures, which results in a difference of 2.76 per cent. When all capital is calculated this amounts to a 0.25 per cent difference.

	Transliteration	**Translation**
	Obv	Obv
1	⸢1+(geš$_2$)⸣ 2(u) 5(aš) 3(bariga) gur a-ra$_2$ 1-kam	1×60+25 *gur* 3 *bariga* 1st time
2	[2(geš$_2$)] 1(aš) 4(bariga) gur a-ra$_2$ 2-kam	[2×60]+1 *gur* 4 *bariga* 2nd time
3	4(geš$_2$) 2(u) 7(aš) 2(bariga) gur	4×60+27 *gur* 2 *bariga*
4	⸢sag⸣-nig$_2$-gur$_{11}$-ra ša-bi-ta	capital, out of which
5	1(geš$_2$) 8(aš) 3*(bariga) gur mu-ku$_x$(DU) guru$_7$ e$_2$ / ^{d}Šamaš	1×60+8 *gur* 3 *bariga* delivered (to) the granary / of the *Šamaš* temple
6	3(geš$_2$) 1(u) 8(aš) 4(bariga) gur šu-ti-a *gi-mi-lum*	3×60+18 *gur* 4 *bariga* receipt of *Gimillum*
7	mu-ku$_x$(DU) ^{d}Sîn-ereš$_4$ lu$_2$ umma^{ki}	delivery of *Sîn-errēš*, man of Umma
8	giri$_3$ *dam-qum*	transport of *Damqum*
9	5(u) 1(aš) 3(bariga) gur a-ra$_2$ 1-kam giri$_3$ nagar	51 *gur* 3 *bariga* 1st time transport of the / carpenter
10	2(geš$_2$) gur a-ra$_2$ 2-kam	2×60 *gur* 2nd time
11	2(geš$_2$) 5(u) gur a-ra$_2$ 3-kam	2×60+50 *gur* 3rd time

12	giri$_3$ *ṣi-li$_2$*-^{d}Šamaš *u$_3$* lu$_2$-^{d}Amurru	transport of *Ṣillī-Šamaš* and *Awīl-Amurru*
13	5(geš$_2$) 4(u) 1(aš) 3(bariga) uru^{ki} ⸢MAŠ$_2$-ZI⸣	5×60+41 *gur* 3 *bariga al-*MAŠ-ZI
14	sag-nig$_2$-gur$_{11}$-ra ša-bi-ta	capital, out of which
15	5(u) 1(aš) 3(bariga) gur šu-ti-a *gi-mi-lum*	51 *gur* 3 *bariga* receipt of *Gimillum*
16	giri$_3$ nagar a$_2$ ^{giš}ma$_2$ *u$_2$-la* ⸢*id-di-in*⸣	transport of the carpenter, he did not give the / ship fee
17	4(geš$_2$) 4(u) 5(aš) 1(bariga) gur šu-ti-a *gi-mi-lum*	4×60+45 *gur* 1 *bariga* receipt of *Gimillum*
18	3(bariga) 2(ban$_2$) a$_2$ lu$_2$ še-il$_2$	3 *bariga* 2 *ban* wages of the grain porters
19	4(ban$_2$) *ma-aš-ti-tum*	4 *ban* drinks
20	a-ra$_2$ 1(diš)-kam	1st time
21	3(aš) 3(bariga) 1(ban$_2$) gur a$_2$ lu$_2$ ḫun-ga$_2$ / ^{giš}ma$_2$-ḫi-a *u$_3$ ma-aš-ti-tum*	2 *gur* 4 *bariga* 2 *ban* wages of the hired ship / hands and drinks
22	*ša* u$_2$-2(diš)-kam	of day 2
23	1(bariga) 5(ban$_2$) lu$_2$ še-il$_2$	1 *bariga* 5 *ban* grain porters
24	a-ra$_2$ 2-kam	2nd time
	Rev	Rev
25	4(aš) 4(bariga) gur ba-zi	4 *gur* 4 bariga disbursed
26	*šu-taḫ-ru-uṣ-ma* la'u$_4$ nu-tuku	deducted, no arrears acquired
27	giri$_3$ *ṣi-li$_2$*-^{d}Šamaš *u$_3$* lu$_2$-^{d}Amurru	transport of *Ṣillī-Šamaš* and *Awīl-Amurru*
28	uru^{ki} MAŠ$_2$-⸢ZI⸣	al-MAŠ-ZI
29	1(geš$_2$) gur sag-nig$_2$-gur$_{11}$-ra ša-bi-ta	1×60 *gur* capital, out of which
30	3(u) 2(aš) 2(bariga) gur mu-ku$_x$(DU) guru$_7$ e$_2$ / ^{d}Šamaš	32 *gur* 2 *bariga* delivered (to) the granary of the / temple *Šamaš*
31	2(u) 3(aš) gur šu-ti-a *gi-mi-lum*	23 *gur* receipt of *Gimillum*
32	2(aš) 4(bariga) 2(ban$_2$) 4(diš) sila$_3$ a$_2$ lu$_2$ ḫun-ga$_2$ / ^{giš}ma$_2$-ḫi-a⸢*u$_3$*⸣ *ma-aš-ti-tum*	3 *gur* 3 *bariga* 3 *ban* 4 *sila* wages of the hired / ship hands and drinks
33	*ša* u$_4$ 4(diš)-⸢kam⸣	which (is to) the 4th day
34	2(ban$_2$) a$_2$ lu$_2$ še-il$_2$ *ša iš-tu* gu$_2$ [i$_7$-d]a	2 *ban* wage of the grain porters who from the / river banks
35	*a-na* guru$_7$ e$_2$ ^{d}Šamaš *iz-bi-lu-nim*	to the granary of the temple of *Šamaš* carried
36	2(aš) 4(bariga) 4(ban$_2$) 4 sila$_3$ ba-zi	2 *gur* 4 *bariga* 5 *ban* 4 *sila* disbursed
37	*šu-taḫ -ru-uṣ-ma*	deducted
38	l a'u$_4$ 1(aš) 3(bariga) 1(ban$_2$) 6 sila$_3$ gur giri$_3$ / *er$_3$-ra-ba-ni*	arrears 1 *gur* 3 *bariga* 1 *ban* 6 *sila* transport / of *Erra-bani*
39	*u$_3$ i-ba-aš-ši*-dingir	and *Ibašsi-ilum*
40	uru^{ki} *i-di-*^{d}uraš	*al-Idi-Uraš*
41	1(geš u)'1(geš$_2$) 9(aš) še-gur	10×60+1×60+9 *gur* grain
42	sag-nig$_2$-gur$_{11}$-ra ša-bi-ta	capital, out of which
43	1(geš$_2$) 4(u) 1(aš) gur mu-ku$_x$(DU) guru$_7$ e$_2$ / ^{d}Šamaš	1×60+41 *gur* delivery (to) the granary / of the *Šamaš* temple
44	9(geš$_2$) 1(u) 8(aš) 3(bariga) gur šu-ti-a / *gi-mi-lum*	9×60+18 *gur* 3 *bariga* receipt of / *Gimillum*
45	7(aš) 3(bariga) 4(ban$_2$) 4(diš) sila$_3$ gur ba-zi	7 *gur* 3 *bariga* 4 *ban* 4 sila *gur* / disbursed
46	*šu-taḫ-ru-uṣ-ma*	deducted
47	la'u$_4$ 1(aš) 3(bariga) 1(ban$_2$) 6(diš) sila$_3$ gur	arrears 1 *gur* 3 *bariga* 1 *ban* 6 *sila gur*
48	iti šu-numun-a u$_4$ 1(u)-kam	month 4 day 10
49	mu kisal-maḫ e$_2$ ^{d}Šamaš ba-du$_3$	Year a large courtyard in the temple of Samaš / was built (*Warad-Sîn* year 4a)

Notes

1, 2, 9, 10, 11, 20, 24 The form ‘a-ra$_2$ X-number kam’ can be understood as literally ‘times X-ordinal number’ and is used to denote a disbursement whether this disbursement is from an outside institution and takes the form of capital or represents in turn a disbursement to an outside source.

5 Breckwoldt’s collation shows 3(bariga) rather than 4(bariga).

5, 30, 35, 43, 49 George (1993) notes three possibilities for a temple devoted to Utu, as well as multiple entries for his Akkadian equivalent, Šamaš (cf. index, 177 for a listing of entries to temples of the god Šamaš). Entry 457, the e$_2$ ḫi-li was located in Ur and ‘rebuilt for Gungunum by Išme-Dagān’s daughter, Enannatumma’ (George 1993: 98). This seems the most likely candidate for a temple to Šamaš. Entry 915 was located at Sippar and thus outside the kingdom of Larsa (*ibid.*: 135) while entry 1433 appears in the late Early Dynastic period (rebuilt by *Enmetena* of Lagaš, *ibid.*: 170).

7 For Umma, see Groneberg (1980: 245).

13, 28 For this city, see Groneberg (1980: 166). Note that she omits this reference perhaps due to the broken sign forms. However, the traces on the tablet leave little doubt that this is the correct name. The exact location is unknown.

40 For this geographic name, see Groneberg (1980: 106). Its exact location is unknown.

YBC 06216
CDLI number: P307252
Copy: Grice 1919: no. 189
Edition: Breckwoldt 1994: Part V, 162, 163
Collation: 12 November 2013

Date formula: *Rīm-Sîn* of Larsa year 09 (1814 BCE), month 10, day 05.

YBC 06216, of uncertain provenance and attributed to scribe F (Appendix 2.R), ostensibly presents costs for a household distributed from a sealed storage room. The personal names are possibly employed by this household. The mention of a sealed storeroom of the household, as well as the date to *Rīm-Sîn* year 9, potentially links this text to the grain storage bureau discussed in Appendix 2, in which case the household would be one or several temple or palace bureau(s) and scribe F would be acting on this bureau’s behalf.

The scribe who wrote YBC 06216 is difficult to name because, while there is an abundance of personal names, there is no suggestion of who controls this account. However, YBC 06216 can be connected to YBC 07313 based on the personal names: *Ḫuppātum* (line 3), *Puṭram-ilī* (line 4), *Zababa-mušallim* (line 5), and *Atannaḫ-ilī* (line 6) all appear as well as a deduction for the household (lines 1, 2).

Transliteration	**Translation**
Obv	Obv
1(u) 4(aš) še-gur *ma-aš-šar-tum* ⸢*a-na*⸣ [*bi-tim*]	14 gur grain withdrawal for the [household]
8(aš) gur *i-*⸢*ga-*⸣*ia*	8 *gur Igāya*
8(aš) gur *iš-gu-um-*er$_3$-ra	8 *gur Išgun-Erra*
8(aš) gur ^{d}Sîn-*i-ri-ba-am*	8 *gur Sîn-Irībam*
1(aš) gur *ḫu-pa-tum*	1 *gur Ḫuppātum*
1(aš) gur *pu-uṭ-ra-am-i*$_3$*-li*$_2$	1 *gur Puṭram-ilī*
2(aš) gur ^{d}za-ba$_4$-ba$_4$-*mu-ša-lim*	2 *gur Zababa-mušallim*
2(aš) gur ir$_3$-^{d}ba-ba$_6$	2 *gur Warad-Baba*
3(aš) gur *ia-da-a-a-tum*	3 *gur Yadayyatum*
3(aš) gur *i-ri-ba-am-*^{d}Sîn	3 *gur Irībam-Sîn*
2(aš) gur *a-ta-na-aḫ-i*$_3$*-li*$_2$	2 *gur Atannaḫ-ilī*
5(u) 4(aš) še-gur	54 gur grain
ša$_3$ e$_2$ kišib-ba *bi-tim*	in the sealed storeroom of the household
ba-zi	disbursed
Rev	Rev
iti ab-e$_3$ u$_4$ 5-kam	month 10 day 5
mu i$_7$ lagaš^{ki} zag a-ab-ba-še$_3$ mu-un-ba-al-la$_2$	Year in which (*Rīm-Sîn*) dug the Lagaš canal to the shore of the sea (*Rīm-Sîn* year 9).

YBC 06231
CDLI number: P307267
Copy: Breckwoldt 1995/1996: 82, 83
Edition: Breckwoldt 1995/1996: 82

Date formula: *Rīm-Sîn* of Larsa year 08 (1815 BCE), month 03, day 13.

YBC 06231, attributed to *Ṣillī-Šamaš* of the grain storage bureau (Appendix 2.P) and probably from Larsa, describes the delivery by *Ṣillī-Šamaš* of grain from Anzagar-Balamunamḫe to a granary by means of a group of intermediaries.

	Transliteration	**Translation**
	Obv	Obv
1	1(geš'u) 2(geš$_2$) še-⸢gur⸣	10×60+2×60 *gur* grain
2	ša$_3$ an-za-gar$_3$-bala-mu-nam-ḫe$_2$	in Anzagar-Balamunamḫe
3	1(geš'u) 2(geš$_2$) gur	12×60 *gur*
4	mu-ku$_x$(DU) *ṣi-li-*^{d}Šamaš	delivered by *Ṣillī-Šamaš*
5	sag-nig$_2$-gur$_{11}$-ra ša$_3$-bi-ta	Capital, out of which
6	1(geš'u) 1(geš$_2$) 1(u) 1(bariga) gur	10×60+1×60+10 *gur* 1 *bariga*
7	mu-ku$_x$(DU) e$_2$ kišib-ba e$_2$ sila-gid$_2$-da gibil	delivered (to) the sealed storeroom of the new / broad street house
8	3(u) 6(aš) gur a$_2$ ^{giš}ma$_2$-ḫi-a	36 *gur* fees for the various ships
9	2(aš) 2(bariga) gur *ma-aš-ti-tum*	2 *gur* 2 *bariga* drinks
10	3(bariga) 1(ban$_2$) *ma-ak-ku-u*$_2$	3 *bariga* 1 *ban makkû* fee
11	4(aš) 2(bariga) 5(ban$_2$) gur a$_2$ lu$_2$ še-il$_2$	4 *gur* 2 *bariga* 5 *ban* wages of the grain porters
12	1(geš'u) 1(geš$_2$) 5(u) 3(aš) 4(bariga) gur	10×60+1×60+53 *gur* 4 *bariga*
13	mu-ku$_x$(DU) *u*$_3$ ba-zi	delivered and disbursed
14	la'u$_4$ 6(aš) 1(bariga) gur	arrears 6 *gur* 1 *bariga*
15	giri$_3$ ^{d}nanna-ma-an-si$_3$	Transport of *Sîn-iddinam*
16	^{I}dingir-*šu-ba-ni*	*Ilšu-bani*

11	1(bariga) 2(ban$_2$) «1(diš)» *ma-aš-ti-tum*	1 *bariga* 2 *ban* drinks
12	1(aš) 4(ban$_2$) gur ⌜a$_2$⌝ lu$_2$ še-il$_2$	1 *gur* 4 *ban* wages for the grain porters
13	⌜3(geš$_2$)⌝ 4(u) 6(aš) 4(bariga) 4(ban$_2$) 2(diš) / sila$_3$ gur	3×60+46 *gur* 4 *bariga* 4 *ban* 2 *sila*
14	mu-ku$_x$(DU) *u*$_3$ ba-zi	delivered and disbursed
15	la'u$_4$ 1(u) 3(aš) 1(ban$_2$) 8(diš) sila$_3$ gur	difference 13 *gur* 1 *ban* 8 *sila*.
	Rev	Rev
16	giri$_3$ *a-pil-*^{d}Sîn	Transport of *Apil-Sîn*
17	^{I} lu$_2$-^{d}nin-šubur	*Awīl-Ninšubur*
18	^{I} *ni-di-it-tum*	*Nidittum*
19	*u*$_3$ tab-ba-ni	and their partners
20	iti ne-ne-gar u$_4$ 2(u) 5(diš)-kam	Month 5 day 25
21	mu nin-dingir ^{d}Adad *ša* im^{ki}	Year the high priest of *Adad* in Karkar
22	ba-hun-ga$_2$	was installed (*Rīm-Sîn* year 12)

Notes

2 For this city, see Breckwoldt (1995/1996: 68).

YBC 07194
CDLI number: P308169
Copy: Breckwoldt 1995/1996: 87
Edition: Breckwoldt 1995/1996: 87

Date formula: *Rīm-Sîn* of Larsa year 12 (1811 BCE), month 05, day 25.

YBC 07194, attributed to *Ṣillī-Šamaš* of the grain storage bureau (Appendix 2.P) and probably from Larsa, depicts the delivery of grain from one town, perhaps *al-Sîn-nūr-matim* following Breckwoldt, although this is uncertain due to a break in the text, to a sealed storehouse. This delivery is under the responsibility of *Ṣillī-Šamaš* and is carried out by three named intermediaries and their partners.

	Transliteration	**Translation**
	Obv	Obv
1	4(geš$_2$) še-gur sa$_3$ uru^{ki} ⌜^{d}S⌝[în-*nu-ur*$_2$*-ma-*]⌜*ti*⌝	4×60 *gur* grain in *al-S*[*în-nūr-mati*]*m*
2	4(geš$_2$) še-gur	4×60 *gur* grain
3	mu-ku$_x$(DU) *ṣi-li-*^{d}Šamaš	delivery of *Ṣillī-Šamaš*
4	sag-nig$_2$-gur$_{11}$-ra ša$_3$-bi-ta	capital, out of which
5	3(geš$_2$) 1(u) 2(aš) 3(bariga) 2(diš) sila$_3$ gur	3×60+12 *gur* 3 *bariga* 2 sila$_3$
6	mu-ku$_x$(DU) e$_2$ kišib-ba ša$_3$ e$_2$ ki-gal$_2$ gibil sila-dagal- / la gibil	delivered (to) the storeroom of the new broad / house new threshing floor street
7	2(u) gur *ša ṣi-ib-tim*	20 *gur* of interest
8	9(aš) 2(bariga) gur *ru-ub-bu-u*$_2$ *ša* ^{giš}ba-ri$_2$-ga	9 *gur* 2 *bariga* the increase of the *bariga-* / standard vessel
9	mu-ku$_x$(DU) guru$_7$	delivered (to) the granary
10	3(aš) 1(bariga) 4(ban$_2$) gur a$_2$ ma$_2$-ḫi-a	3 *gur* 1 *bariga* 4 *ban* fee for the various ships

11	1(bariga) 2(ban$_2$) «1(diš)» *ma-aš-ti-tum*	1 *bariga* 2 *ban* drinks
12	1(aš) 4(ban$_2$) gur ⸢a$_2$⸣ lu$_2$ še-il$_2$	1 *gur* 4 *ban* wages for the grain porters
13	⸢3(geš$_2$)⸣ 4(u) 6(aš) 4(bariga) 4(ban$_2$) 2(diš) / sila$_3$ gur	3×60+46 *gur* 4 *bariga* 4 *ban* 2 *sila*
14	mu-ku$_x$(DU) *u*$_3$ ba-zi	delivered and disbursed
15	la'u$_4$ 1(u) 3(aš) 1(ban$_2$) 8(diš) sila$_3$ gur	difference 13 *gur* 1 *ban* 8 *sila*.
	Rev	Rev
16	giri$_3$ *a-pil-*^{d}Sîn	Transport of *Apil-Sîn*
17	^{I} lu$_2$-^{d}nin-šubur	*Awīl-Ninšubur*
18	^{I} *ni-di-it-tum*	*Nidittum*
19	*u*$_3$ tab-ba-ni	and their partners
20	iti ne-ne-gar u$_4$ 2(u) 5(diš)-kam	Month 5 day 25
21	mu nin-dingir ^{d}Adad *ša* im^{ki}	Year the high priest of *Adad* in Karkar
22	ba-hun-ga$_2$	was installed (*Rīm-Sîn* year 12)

Notes

1 For this city see Groneberg (1980: 205) and Breckwoldt (1995/1996: 68). Restoration follows Breckwoldt (1995/1996: 87) though this is by no means certain.

YBC 07195
CDLI number: P308170
Copy: Grice 1919: no. 175
Edition: Breckwoldt 1994: Part V, 153–155
Collation: 12 November 2013; Breckwoldt 1994: Part V, 153–155

Date formula: *Rīm-Sîn* of Larsa year 06 (1817 BCE), month 12, day –.

YBC 07195, attributed here to the archive of *Sîn-māgir* (Appendix 2.P), is a balanced account of grain disbursed to two towns over a three-month period. The last two lines inform the reader that the remainder was brought from perhaps two villages, *al-Iškun-Ea* and *al-Abī-sarē* by *Sîn-māgir*. This is perhaps a part of a shipment to Larsa. This may be connected with AO 06763 and Riftin 1937: no. 054 and then would suggest that these excess remainders made up at least part of the deliveries to the grain storage bureau. Moreover, YBC 07211 suggests that the source of this may have been the city of Larsa and the grain storage bureau itself. Grain is stored at Larsa and disbursed to the local villages for production of the next year's crop, the remainder to be returned to Larsa with the surplus crop. This text probably makes up part of *Sîn-māgir*'s professional records dealing with the grain storage bureau.

	Transliteration	**Translation**
	Obv	Obv
1	⌜7(geš$_2$) 2(u)⌝ še-gur	7×60+20 *gur* grain
2	7(geš$_2$) 2(u) gur	7×60+20 *gur*
3	sag-nig$_2$-gur$_{11}$-ra ša-bi-ta	capital, out of which
4	2(geš$_2$) 1(u) 5(aš) gur še-numun *u*$_3$ ša$_3$-gal gu$_4$ / *ta-ad-ni-in-tum*	2×60+15 *gur* seed-grain and additional ox fodder
5	1(u) 8(aš) gur *ta-ad-ni-in-tim ša* iti 2(diš)-kam	18 *gur* additional of the 2nd month
6	3(u) gur še-ba 6(diš) lu$_2$ ša$_3$-gu$_4$	30 *gur* grain rations of 6 ox-drivers
7	2(u) 7(aš) gur *ta-ad-ni-in-tim* ⌜gu$_4$⌝-ḫi-a$^{!}$ *ša* iti / 3(diš)-kam	27 *gur* additional oxen of the 3rd month
8	1(u) gur *a-bu-ra-bi*	10 *gur Abu-rabi*
9	5(aš) gur ^{d}Sîn-ereš$_4$	5 *gur Sîn-errēš*
10	5(aš) gur dug$_3$-*ṣi-la-šu*	5 *gur Ṭāb-ṣillāšu*
11	še-ba sipa udul-e-ne	grain rations of the sheep- and cow-herdsmen
12	4(u) 5(aš) gur *a-na* eg$_2$ *ša-pa-ki-im*	45 *gur* to heap up the levee
13	2(u) gur *a-na šu-ur* ^{giš}kiri$_6$^{im}	20 *gur* to cut the reeds
14	*ka-sa*$_3$*-mi-im*	of the garden
15	1(u) gur *ta-am-lu-u*$_2$ *ša* a$_2$ im-du$_3$-a	10 *gur* fillings for the built edge
16	*u*$_3$ ^{giš}kiri$_6$	and garden
17	2(u) 6(aš) 2(bariga) gur sa$_{10}$ ^{giš}kiri$_6$	26 *gur* 2 *bariga* price of the garden
18	8(aš) gur ša$_3$-gal gu$_4$-niga ša ⌜x x x⌝ ri	8 *gur* fodder of the fattened ox…
19	i-⌜da$^{?}$⌝ [x]⌜x⌝	…[…]
20	2(aš) gur giri$_3$ ir$_3$-^{d}nanna *i-nu-u*$_2$*-ma*	2 *gur* transport of *Warad-Sîn* when
	LoE	LoE
21	*i-na* bad$_3$-tibira^{ki} ^{giš}ka-[…]	in bad-tibira ka[…]
22	*u*$_2$*-ša-ar-ki-bu*	he loaded
	Rev	Rev
23	6(aš) gur a$_2$ ma$_2$-ḫ i-a *ša* in-nu-[da]	6 *gur* various fees of ships which carried
24	*iš-ši-a-*[*nim*]	straw
25	3(u) 2(aš) 2(bariga) gur še-ba geme$_2$ ir$_3$-ḫ i-a	32 *gur* 2 *bariga* grain rations female and male / slaves
26	6(geš$_2$) 1(u) 9(aš) 4(bariga) gur	6×60+19 *gur* 4 *bariga*
27	uru^{ki} *iš-ku-un*-e$_2$-a	*al-Iškun-Ea*
28	3(u) gur *a-na* a-ša$_3$ *mu-ḫa-al-lu-u*$_2$	30 *gur* to cut the field
29	*ka-sa*$_3$*-mi-im*	of *Muḫallu*
30	6(aš) gur *ta-ad-ni-in-tim* gu$_4$ *ša* iti 2(diš)-kam	6 *gur* additional ox fodder of the 2nd month
31	3(u) 6(aš) gur	36 *gur*
32	uru^{ki} *a-bi-sa-re-e*	*al-Abī-sarē*
33	6(geš$_2$) 5(u) 5(aš) 4(bariga) gur	6×60+55 *gur* 4 *bariga*
34	*si-i*$_3$*-tum* 4(aš) 1(bariga) gur	balance 4 *gur* 1 *bariga*
35	*ša* ^{d}Sîn-*ma-gir iš-tu ka-ap-ri-im*	which *Sîn-māgir* from the village
36	*u*$_2$*-ša-bi-lam*	brought here
37	⌜iti⌝ še-kin-ku$_5$	month 12
38	⌜mu⌝ e$_2$ ^{d}bara-ul-e [gar-ra]	Year the temple of Baraule[garra]
39	[ša$_3$] Adab^{ki}	[in] Adab
	UpE	UpE
40	[mu]-un-du$_3$-a	was built (*Rīm-Sîn* year 6)

Notes

27 For this city see Groneberg (1980: 114) as well as Breckwoldt (1995, 1996: 68).

YBC 07473
CDLI number: P308416,
Copy: Grice 1919: no. 207
Edition: Kozyreva 1988: 49, 182; Leemans 1950: 71ff; 1960: 143ff; Breckwoldt 1994: Part IV, 167–170; Middeke-Conlin forthcoming a
Collation: 12 November 2013

Date formulas: *Warad-Sîn* year 12 to *Rīm-Sîn* of Larsa year 04 (1823-1819 BCE), month 01, day 29.

YBC 07473,[4] attributed to *Itti-Sîn-milki* (Appendix 2.H), is a balanced account listing capital in sesame, wool and sheep. Capital is assessed by silver equivalents in four different years. All capital is received by *Itti-Sîn-milki* merchant overseer of *Zarbilum*, who also expends this capital, presumably during the same period.

	Transliteration Obv	**Translation** Obv
1	2(geš$_2$) gur še-giš-i$_3$	2×60 *gur* sesame
2	kar-bi 1(bariga) 1(ban$_2$) 5(diš) sila$_3$-ta	its fixed rate (is) 1 *bariga* 1 *ban* 5 *sila* per (*gin* / silver)
3	ku$_3$-bi 8 ma-na	its silver (is) 8 *mana*
4	1(u) gu$_2$ siki-gin kar-bi 1(u) ma-na-ta	10 *gu* average wool its fixed rate (is) 10 *mana* / per (*gin* silver)
5	ku$_3$-bi 1(diš) ma-na	its silver (is) 1 *mana*
6	ša$_3$ mu e$_2$ ^{d}nin-ga$_2$-nu-ur$_2$ ša$_3$ maš$_3$-gan$_2$-šabra^{ki} / mu-un-du$_3$-a	in the year the temple of Nin-gaug? in Maškan- / Šapir he had built (*Warad-Sîn* year 12)
7	4(u) udu-nita$_2$ s[a$_{10}$] 1(diš) udu-e 1(diš) gin$_2$-ta	40 rams (according to the) price 1 *gin* per 1 sheep
8	ku$_3$-bi 2/3 ma-na	its silver (is) 2/3 *mana*
9	ša$_3$ mu ^{d}*ri-im*-^{d}Sîn lugal	in the year *Rīm-Sîn* (became) king (*Rīm-Sîn* year / 01)
10	2(geš$_2$) gur še-giš-i$_3$ kar-bi 2(bariga)-ta	2×60 *gur* sesame its fixed rate (is) 2 *bariga* per / (*gin* silver)
11	ku$_3$-bi 5(diš) ma-na	its silver (is) 5 *mana*
12	ša$_3$ mu e$_2$ ^{d}Adad ša$_3$ larsa^{ki} ba-du$_3$	in the year the temple of Adad in Larsa was built / (*Rīm-Sîn* year 2)
13	2(geš$_2$) gur še-giš-i$_3$ kar-bi 1(bariga) 5(ban$_2$)-ta	2×60 *gur* sesame its fixed rate (is) 1 *bariga* 5 *ban* / per (*gin* silver)
14	ku$_3$-bi 5(diš) 1/3 ma-na 7(diš) gin$_2$ igi-4(diš)-gal$_2$ / 5(diš) še	its silver (is) 5 1/3 *mana* 7 *gin* one-4th 5 *še*
15	ša$_3$ mu 4(diš) urudu alam *ku-du-ur-ma-bu-uk* / e$_2$ ^{d}nanna-še$_3$	in the year 4 copper statues of *Kudur-Mabuk into* / the temple of Nanna
16	i-ni-in-ku$_4$-re	He brought (*Rīm-Sîn* year 3)

[4] After Middeke-Conlin (forthcoming a).

17	[ni]g$_2$-ka$_9$ til-la	finished account
18	[iti] bara$_2$-zag-gar u$_4$ 2(u) 9(diš)-kam	Month 1, day 29
19	[m]u e$_2$ ^{d}Ištar ^{d}nanna *u*$_3$ ^{d}en-ki ša$_3$ larsa^{ki} / mu-un-du$_3$-a	Year the temple of *Ištar*, *Nanna*, and Enki of Larsa / were built (*Rīm-Sîn* year 4)
20	2(u) ma-na 7(diš) gin$_2$ igi-4(diš)-gal$_2$ / 5(diš) še ku$_3$-babbar	20 *mana* 7 *gin* one-4th 5 *še* silver
21	šu-ti-a *it-ti-*^{d}Sîn-*mi-il-ki* ugula dam-gar$_3$ / *zar-bi*$_2$*-lum*^{ki}	receipt of *Itti-Sîn-milki*, merchant overseer of / *Zarbilum*
22	sag-nig$_2$-gur$_{11}$-ra ša$_3$-bi-ta	Capital, out of which
23	4(u) 9(diš) tug$_2$-ḫ i-a ka[r-bi 3(diš) gi]n$_2$-ta	49 assorted garments, its rate 3 *gin* per (garment)
24	ku$_3$-bi 2(diš) 1/3 ma-na [7(diš) gin$_2$]	its silver 2 1/3 *mana* 7 *gin*
25	1(u) tug$_2$-ḫi-a kar-bi ⌜4(diš)⌝ gin$_2$-ta	10 assorted garments, its fixed rate 4 *gin* per / (garment)
26	ku$_3$-bi 2/3 ma-na	its silver 2/3 *mana*
27	5(diš) utul$_2$-ḫi-a ku$_3$-bi 1(diš) 2/3 ma-na	5 assorted large bowls, its silver 1 2/3 *mana*
28	1(diš) ma-na ku$_3$-babbar sa$_{10}$ ^{na4}ellag$_2$-babbar-dili	1 *mana* silver, price of an agate$^{(?)}$ bead
29	*u*$_3$ ^{na4}da-gaz-babbar-dili	and block of agate$^{(?)}$
30	⌜2(diš)⌝ ḫ ar-šu ku$_3$-babbar ki-la$_2$-bi 1(u)8(diš) / 1/2 gin$_2$	2 silver rings, their weight 18 1/2 *gin*
31	*a-na* dumu-munus *ši*$_4$*-im-ti-iš-ša-an*	to the daughter of *Šimti-iššan*
32	*i-nu-u*$_2$*-ma a-wi-lum it-ti* dumu-munus lugal	when the citizen went with the princess,
33	*ša a-na* bad$_3$-an^{ki} *in-na-ad-nu a-na* / *zar-bi*$_2$*-lum*^{ki} *il-li-ku*	who was given to *Dēr* (and) to *Zarbilum*
34	⌜x⌝[…]⌜5(diš)$^{(?)}$⌝ udu-nita$_2$ ku$_3$-bi 2(diš) 1/2 gin$_2$ Remainder lost	[…] 5 rams, its silver 2 1/2 *gin* Remainder lost
	Rev	Rev
	Beginning lost	Beginning lost
35'	⌜5(diš)⌝[..]⌜ku$_3$-bi 1(diš) ma-na 8(diš)$^{?}$⌝ gin$_2$	5 […] its silver x *mana* 8+*gin*
36'	š[a$_3$ mu ^{d}*ri-i*]*m*-^{d}Sîn lugal	i[n the year *Rī*]*m-Sîn* (became) king / (*Rīm-Sîn* year 1)
37'	3(diš) […]⌜x⌝-ra ku$_3$-bi 1(diš) ma-na 1(u) gin$_2$	3 […] its silver 1 *mana* 10 *gin*
38'	2(diš) […] ku$_3$-bi 1/3 ma-na 5(diš) gin$_2$	2 […] its silver 1/3 *mana* 5 *gin*
39'	2(diš)⌜utul$_2$⌝ ku$_3$-bi 1/2 ma-na	2 large bowls$^{?}$ its silver 1/2 *mana*
40'	2(u) ^{tug2}sar-zum ku$_3$-bi 1(diš) ma-na 6(diš) 2/3 / gin$_2$	20 sarzum-garments, its silver 1 *mana* 6 2/3 *gin*
41'	2(u) ^{tug2}bar-dul$_8$ ku$_3$-bi 1(diš) ma-na	20 robes, its silver 1 *mana*
42'	2(diš) ma-na an-na kar-bi 1(u) gin$_2$-ta	2 *mana* tin, its fixed rate 10 *gin* per (*gin* silver)
43'	ku$_3$-bi 1(u) 2(diš) gin$_2$	its silver 12 *gin*
44'	ša$_3$ mu e$_2$ ^{d}Adad ša$_3$ ⌜larsa^{ki}-ma⌝ ba-du$_3$	in the year the temple of Adad in Larsa was built / (*Rīm-Sîn* year 2)
45'	1(diš) ^{tug2}*ku-uš-š*[*a-tum* ku$_3$-bi x gi]n$_2$	1 *kušš*[*atum*-garment, its silver X she]kel
46'	1(u) 1(diš) ^{tug2}sar-zum [ku$_3$-b]i ⌜1/2⌝ [ma]-na / 3(diš) gin$_2$	11 *sarzum*-garments, i[ts value] 1/2$^{?}$ [mi]na 3 *gin*
47'	2(diš) ḫ ar-šu ku$_3$-babbar ⌜ki⌝-la$_2$-bi 1/3 ma-na	2 silver bracelets, its weight 1/3 *mana*
48'	nig$_2$-ba dumu-munus ur-^{d}nanna *ša a-na* e$_2$ / *a-pil*-ku-bi *in-na-ad-nu*	gift of the daughter of *Ur-Nanna* who was given to / the household of *Apil-kubi*
49'	1(u) gin$_2$ ku$_3$-ba[bbar x] 2(diš) tug$_2$-e$_2$-a *a-na* / ^{giš}ma$_2$-ḫi-a gu-la	10 *gin* si[lver x]of 2 sail-cloths$^{?}$ for various large / ships
50'	ša$_3$ mu ⌜4(diš) urudu⌝ alam *ku-du-ur-ma-bu-uk* / e$_2$ ^{d}nanna-še$_3$	in the year 4 copper statues of *Kudur-Mabuk into* / the temple of Nanna
51'	i-ni-in-ku$_4$-re	he brought (*Rīm-Sîn* year 3)

52’	1/2 ma-[n]a ku$_3$-gi kar-bi 6(diš) 1/2 gin$_2$-ta	1/2 *mana* gold, its fixed rate 6 1/2 *gin* per (*gin* / gold)
53’	ku$_3$-bi 3(diš) ma-na 1(u) 5(diš) gin$_2$	its silver 3 *mana* 15 *gin*
54’	kurum$_6$ *gi-mi-lum*	allocation of *Gimillum*
55’	2(u) ^{tug2}sar-zum kar-bi 2(diš) 2/3 gin$_2$-ta	20 sarzum-garments, its fixed rate 2 2/3 *gin* per / (garment)
56’	ku$_3$-bi 5/6 ma-na 3(diš) 1/3 gin$_2$	its silver 5/6 *mana* 3 1/3 *gin*
57’	*ša a-na* nig$_2$-ba^{meš} *ša* kaš-de$_2$-a ^{d}Ištar zabalam^{ki}	which for the gifts of the libations of Inanna of / *Zabalum*
58’	1(u) 7(diš) 2/3* ma-na 4(diš) gin$_2$ ku$_3$- / babbar	17 2/3 *mana* 4 *gin* silver
59’	ba-zi	disbursed
60’	*si-i$_3$-tum* 2(diš) 1/3 ma-na 3(diš) gin$_2$ igi 4(diš)- / gal$_2$ 5(diš) še ku$_3$-babbar	balance 2 1/3 *mana* 3 *gin* one-4th 5 *še* silver
61’	ki *it-ti-*^{d}Sîn-*mi-il-ki*	from *Itti-Sîn-milki*
62’	iti bara$_2$-zag-gar u$_4$ 2(u) 9(diš)-kam	Month 1, day 29
63’	[m]u e$_2$ ^{d}Ištar ^{d}nanna *u$_3$* ^{d}en-ki ša$_3$ Larsa^{ki}	Year the temple of *Inanna*, *Nanna*, and Enki of / Larsa
64’	mu-un-du$_3$-a	were built (*Rīm-Sîn* year 4)

Notes

28, 29 This stone is uncertain. Von Soden (1985: 794) notes Akkadian *nirpappardil (dil)lû*, Sumerian ^{na4}nir$_2$-babbar-dil(-dil), describing it ‘zwei Steinarten’. Black et al. (2000: 264) translates *pappardilium* as ‘agate’. CAD (P: 107, 108) describes *pappardilû* as ‘a whitish semiprecious stone’ while definition b states ‘used as seals, ornaments, jewelry’. Halloran (2006: 60) translates ^{na4}ellag$_2$ as ‘small balls, beads, pips made of carnelian, lapis, gold, silver, copper, and bronze manufactured in great numbers - used to decorate necklaces and collars’ and associates ^{na4}ellag$_2$ with Akkadian *kalītum* and *takpītum*. da-gaz, is translated ‘block’ here (cf. *ibid.*: 38: ‘(small) block of stone or bronze mortar’).

40’ This garment is uncertain.

41’ For ^{tug2}bar-dul$_8$ see AO 06760: 16.

45’ See Michel and Veenhof (2010: 234) for this garment.

58’ The tablet shows traces of a wedge rendering 2/3, against the copy which shows 1/3.

YBC 07744
CDLI number: P308664
Copy: Stol 1982: no 22
Edition: Stol 1982: 166, 167
Collation 13 December 2013

Date formula: *Hammu-rābi* of Babylon year 41 (1752 BCE), month 02, day 20.

YBC 07744, attributed to *Sîn-muštāl* (Appendix 2.LL) and possibly from Ur or recording activity around Ur, lists a series of transactions in which fish, described either in weight or capacity, are assessed by a silver value and then provided to a merchant, *Watar-Šamaš* the overseer of 5, by another merchant, *Sîn-muštāl* the merchant overseer at Ur. Because of the content of this text, it's probably a part of the system in which merchants act as intermediaries assessing excess capital owned or controlled by the crown in silver.

	Transliteration	**Translation**
	Obv	Obv
1	3(u) 5(aš) gu$_2$ ⸢dig⸣-ku$_6$ ša$^!$ 3(diš) šu-ši-ta$^!$-am$_3$	35 *gu* softened-fish which are 3 sixties (*gu* fish)
2	ganba 4(diš) šu-ši-ta-am$_3$	going rate 4 sixties per (*gin* silver)
3	ku$_3$-bi 1/3 ma-na 6 gin$_2$ igi 4(diš)-gal$_2$	its silver 1/3 *mana* 6 *gin* one-4th
4	1(u) 5(aš) gu$_2$ a-kar$_2$-kar$_2$^{ku6} *ša* 1(geš'u)-ta-am$_3$	15 *gu* akarkar fish which are 10×60 per (*gu* fish)
5	ganba 3(geš'u)-ta-am$_3$	going rate 30×60 per (*gin*)
6	ku$_3$-bi 5(diš) gin$_2$	its silver 5 *gin*
7	4(aš) gur sim^{ku6} ganba 2(bariga) 3(ban$_2$)-ta-am$_3$	4 *gur* simma fish going rate 2 *bariga* 3 *ban* per / (*gin* silver)
8	ku$_3$-bi 8(diš) gin$_2$	its silver 8 *gin*
9	5(aš) gur x x gur ku$_6$ ganba x x [x]	5 *gur* x x *gur* fish going rate x x […]
10	ku$_3$-bi 5(diš) gin$_2$	it's value 5 *gin*
	Rev	Rev
11	2(aš) ⸢gur⸣ x x (x) ku$_6$ ganba 1(aš) 1(bariga) / 4(ban$_2$)*-ta-am$_3$	2 *gur* x x fish going rate 1 *gur* 1 *bariga* 4 *ban* / per (*gin* silver)
12	ku$_3$-bi 1(diš) 1/2 gin$_2$	its silver 1 1/2 *gin*
13	šu-nigin 2/3 ma.na 5(diš) 2/3 gin$_2$ [1(u)]⸢5(diš)⸣ [še]	total 2/3 *mana* 5 *gin* [15 še]
14	šu-ti-a *wa-tar-*^{d}Šamaš ugula-⸢nam⸣ 5(diš)	receipt *Watar-Šamaš* overseer of 5
15	nig$_2$-šu ^{d}Sîn-*mu-uš-ta-al*	property of *Sîn-muštāl*
16	ugula-dam-gar$_3$ Uri$_2$^{ki}	Merchant overseer of Ur
17	ki *i-tur$_2$-rum*	from *Iturram*
18	ugula *i$_3$-li$_2$-i-din-nam*	overseer of *Ilī-iddinam*
19	iti gu$_4$.si.sa$_2$ u$_4$ 2(u)-kam	month 2 day 20
20	⸢mu⸣ ^{d}taš-me-tum inim šag$_5$-šag$_5$-ga-ni	Year at the command of Tašmetum,
	UpE	UpE
21	⸢sag⸣-bi mu-un-il$_2$-la	(*Hammu-rābi*) raised (*Hammu-rābi* year 41)

Notes

1 The 'NI' sign cannot be read as i$_3$, 'oil', but dig, 'soft' because the item is both measured by weight and then assessed by concrete numbers, which are then assessed in a silver value. An oil would be measured by capacity. The Akkadian word *labākum* is connected to the Sumerian word dig by CAD (L: 7) and then associated by Stol (1984: 106) with a process of softening by soaking overnight in water or boiling, especially of meats . Its use here implies the fish were softened by soaking or boiling.

4 The variety of fish described here is uncertain. Perhaps a-kar$_2$-kar$_2^{ku6}$ can be divided into ‘a-’ or ‘water’, and ‘kar$_2$-kar$_2$’, Akkadian *napāḫum*, ‘to be bloated, swollen’ (CAD N: 263) and thus translated ‘swollen water fish’.

7 sim^{ku6} is perhaps a shortened form of sim-ma^{ku6} found on the ED list of fish, line 87. See also Salonen (1970: 18, 129–132, 137, 150, 184, 199, 223, 224, 240, 242) where it is listed sim-ma-ḫa.

11 Collation revealed 4(ban$_2$) rather than 5(ban$_2$). Stol (1982: 167) notes Gary Beckman saw 5 when he collated this tablet. However, what could be understood as a fifth wedge seems to be in fact a splitting in the stylus. The rate works with 4 *ban* and not 5 *ban* (as stated by Stol citing a private communication with Waetzoldt and Shanati-Müller).

YBC 07787
CDLI number: P308706
Copy: Stol 1982: no. 20
Editions: Stol 1982: 165; Breckwoldt 1994: part V, 45

Date formula: *Hammu-rābi* of Babylon year 43 (1750 BCE), month 11, day 30.

YBC 07787, attributed here to *Iddin-Ištar* (Appendix 2.OO) and probably from Larsa, can be described as a *sūtu* text, that is, a text which appears on first sight to be a sales contract but is probably a part of a system assessing excess crown capital in silver by merchant intermediaries (see Chaps. 3 and 4). *Iddin-Ištar* acts as an intermediary selling fish on behalf of the crown to another merchant, *Pirḫum*, in order to produce silver capital for crown use. In this text, only 2/3 silver value is attested for in the text leaving 1/3 value unaccounted for. For further discussion of this, see Stol (1982), Breckwoldt (1994), Rede (2005) and Földi (2014).

	Transliteration	**Translation**
	Obv	Obv
1	sam$_2$ 1/3 ma-na ku$_3$-babbar	equivalent of 1/3 *mana* silver
2	nig$_2$-gu$_7$ a-ab-ba ku$_6$	edible sea fish
3	*u$_3$* zu$_2$-lum e$_2$-gal	and dates of the palace
4	ki *i-din-iš$_8$-tar$_2$* dumu *a-ḫu-wa-qar*	from *Iddin-Ištar* son of *Aḫu-waqar*
5	^{m}*pi-ir-ḫu-um*	*Pirḫum*
6	*a-na* 6(diš) 2/3 gin$_2$ ku$_3$-babbar	for 6 2/3 *gin* silver
7	*i-ša-am*	bought
8	ša$_3$-bi-ta	out of it
9	3(diš) gin$_2$ ku$_3$-babbar *le-qu*	3 *gin* silver taken
	LoE	LoE
10	*li-ib-ba-šu ta-a-ab*	his heart is satisfied
	Rev	Rev
11	*si-i$_3$-tum* 3(diš) 2/3 gin$_2$ ku$_3$-babbar	balance 3 2/3 *gin* silver
12	*a-na su$_2$-tim* i$_3$-la$_2$-e	he will weigh out as the concession
13	igi *a-li$_2$-lu-mur*	before *Ali-lūmur*
14	igi *be$_2$-la-nu-um*	before *Bēlānum*
15	igi nig$_2$-gi-ia	before *Niggiya*
16	igi *i$_3$-li$_2$-lu-mur*	before *Ilī-lūmur*
17	kišib-a-ni ib$_2$-ra	they impressed their seals
18	iti udru (ZIZ$_2$.A) u$_4$ 3(u)-kam	month 11 day 30
19	mu ud-kib-nun^{ki}	Year Sippar

	UpE	UpE
20	[uru]-ul ^{d}Šamaš-ke$_4$	the eternal (city) of Šamaš (*Hammu-rābi* year / 43a)
	Seal impressions:	Seal impressions:
1	*i-din-*^{d}Ištar	*Iddin-Ištar*
2	dumu *a-ḫu-wa-qar*	son of *Aḫu-waqar*
3	ir$_3$ ^{d}šul-pa-e$_2$	servant of Šulpae

Notes

2 Literally ‘nig$_2$-gu$_7$’, ‘things edible’ and ‘a-ab-ba’, ‘sea’, in apposition to ‘fish’, ‘ku$_6$’.

1.A.b

Ashm 1922-277
CDLI number: P347349
Copy: Dalley 2005: no. 006
Edition: Robson 2014: text 29[5]
Collation, 8 April 2014

Date formula: *Hammu-rābi* of Babylon year 35 (1758 BCE), month 03, day 20.

Ashm 1922-277, produced by scribe P of the grain production archive (Appendix 2.GG), is a text in tabular format that reports activities carried out around Ur. It presents an assessment of total land as well as estimated yeilds in preparation of farming several fields of the palace and the temples of Nanna (*Sîn*), located near Nirda and *al-kurḫiānu* in Ur’s hinterland. Because the text reports activity around Ur, it is suggested that this text, as well as Ashm 1923-340, were produced at Ur, although it is also possible this text was produced in Larsa where oversight of these estates may have been carried out. In Ashm 1922-277, a distinction is made between fields with and without furrows, with grain estimated for furrowed fields and no grain estimated for unforrowed fields. Comparison can be made between this text and Ashm 1923-311, an equally complex text but presented in prosaic format.

[5]For transliteration and translation, see Robson (2014: OECT 15, 006 [tabular account]), http://oracc.museum.upenn.edu/obta/P347349/html. Accessed June 30, 2018.

Transliteration

	1	2	3	4
Obv				
1	igi-du-a *šu-ku-un-na* a-ša$_3$ ⸢aga⸣-uš$^{\text{meš}}$ *a-ḫi-a-tim*			
2	nig$_2$ e$_2$-gal u$_3$ nig$_2$ e$_2$ $^{\text{d}}$nanna nir-da⸢$^{\text{ki}}$⸣ u$_3$ uru *kur-ḫi-a-nu*$^{\text{ki}}$			
3	a-ša$_3$ ab-sin$_2$	še-bi	ab-sin$_2$ še-	nu mu-bi-um
4	1(bur'u) 4(bur$_3$) 1(eše) 2(aš) 5(diš)	4(geš$_2$) 1(u) 2(aš) 4(bariga) 2(ban$_2$) 2(diš) 2/3	1(bur$_3$) 1(eše) 2(as)	*ša* aga-uš$^{\text{meš}}$ *ša a-na* ad-da-ni *it-bu-u*$_2$
5	ša$_3$-ba	1(u) 9(aš) 2(bariga) 5(ban$_2$) 5		uru$_4$ ensi$_2$
6	1(bur'u) 1(eše) 5(aš)	2(geš$_2$) 3(u) 6(aš) 5(ban$_2$)	1(bur$_3$) 2(eše) ⸢4(aš)*⸣ 1(geš$_2$) 1(u)	*ša* aga-uš$^{\text{meš}}$ *ki-ma* erin$_2$ uš$_2$ zaḫ$_2$
7	ša$_3$-ba	3(u) 4(bariga) 1(ban$_2$) gur		uru$_4$ ensi$_2$
8	8(bur$_3$) 5 sar	2(geš$_2$) 1(u) 3(aš) 1(bariga) 1(ban$_2$) 1 sila$_3$	1(bur$_3$) 1(eše) 4(aš)	*ša* erin$_2$ uš$_2$ zaḫ$_2$
9	ša$_3$-ba	1(u) 2(aš) 2(bariga) 3(ban$_2$)		uru$_4$ ensi$_2$
10	1(bur$_3$) 2(eše) 5(aš)	4(u) 1(aš) 3(ban$_2$) 3 1/3 sila		dub-sar $^{\text{d}}$*za-ba$_4$-ba$_4$-na-ṣir*
11	3(bur'u) 5(bur$_3$)	9(geš$_2$) 4(u) 3(aš) 1(bariga) 5(ban$_2$)	4(bur$_3$) 2(eše) 4(aš)	aga-uš nig$_2$-šu $^{\text{d}}$*uraš-mu-ba-li$_2$-iṭ*
12	1(u) sar	7 sila$_3$	1(geš$_2$) 1(u)	
13	ša$_3$-ba	1(geš$_2$) 2(aš) 4(bariga) 3(ban$_2$) 5(diš) sila$_3$		uru$_4$ ensi$_2$
14	1(eše)	3(aš) 1(bariga) 4(ban$_2$)		erin$_2$ uš$_2$ uru$_4$ $^{\text{d}}$*uraš-mu-ba-li$_2$-iṭ*
15	4(aš)	3(aš) 3(bariga) 4(ban$_2$) 5(diš)	*ša*	erin$_2$ *i$_3$-di* uru$_4$ e$_2$ igi-du$_8$-bi
16				*u$_3$ zi-kir-i$_3$-li$_2$-šu*
17	1(eše) 4(aš)	7(aš) 2(ban$_2$) 5(diš)		nig$_2$-šu *in-bu-ša*
18	3(bur'u) 5(bur$_3$)	9(geš$_2$) 5(u) 2(bariga) 2(ban$_2$) 2(diš) sila$_3$	4(bur$_3$) 2(eše) 4(aš)	⸢ša$_3$⸣ a-⸢ša$_3$ šuku⸣$^{\text{meš}}$
19	1(eše) 4(aš) 1(u)		1(geš$_2$) 1(u)	aga-uš$^{\text{meš}}$
20	ša$_3$-ba	1(geš$_2$) 6(aš) 3(bariga) 2(ban$_2$)		uru$_4$ ensi$_2$
loE				
21	⸢8$^{?}$(bur$_3$)⸣ 3(aš)	2(geš$_2$) 1(u) 8(aš) 2(bariga) 2(ban$_2$) 1(diš) 2/3 sila$_3$		*ša a-ḫi-a-tim*
rev				
22	1(bur'u) 5(bur$_3$) 2(eše)	3(geš$_2$) 2(u) 7(aš) 1(ban$_2$) 6 2/3	[a-	]⸢ša$_3$$^{?}$⸣ *ni-di-it* e$_2$-gal
23	4(aš) 1(u)	uru$_4$	⸢x x⸣	nig$_2$-kud šu-ri-a
24		ša$_3$-ba 1(aš) 1(bariga) 1(ban$_2$) 5(diš)		uru$_4$ ensi$_2$
25	5(bur'u) 9(bur$_3$)	1(geš'u) 5(geš$_2$) 3(u) 6(aš) 1/3 sila$_3$	⸢8$^{?}$(bur$_3$)⸣	nig$_2$ e$_2$-gal
26	1(eše) 5(aš) 2(u)			

27		ša$_3$-ba 1(geš$_2$) 7(aš)* 4(bariga) [3(ban$_2$)]⸢4(diš)+ sila$_3$⸣		uru$_4$ ensi$_2$ e$_2$ ^{d}nanna
28		1(u) 8(aš) 4(bariga) ⸢2+(ban$_2$)⸣	*ki-ma*	*a-bi-ša it-bu-u$_2$*
29		še gur […]	*ki-ma*	erin$_2$ uš$_2$ zaḫ$_2$ *it-bu-u$_2$*
30		1(geš$_2$) 4(u) 8(aš) ⸢4$^?$(bariga)⸣[…]	4(diš) 2/3	*ša* erin$_2$ uš$_2$^{meš}
31		uru$_4$	⸢d⸣*uraš-*	*mu-ba-li$_2$-iṭ*
32		nir-da⸢ki⸣ […]		
33	5(bur$_3$) 1(eše)	1(geš$_2$) 8(aš) 4(bariga) 2(ban$_2$) 6(diš) ⸢ 2/3⸣	1(bur$_3$) 3(aš)	aga-uš nig$_2$-šu *i-din-^{d}la-ga-ma-al*
34		ša$_3$-ba 4(u) 1(aš) 3(bariga) ⸢4$^?$(ban$_2$)⸣ 3(diš) 1/3 sila$_3$		uru$_4$ ensi$_2$ e$_2$ ^{d}nanna [x] ⸢al*⸣
35	2(bur$_3$) 1(eše)	1(geš$_2$) 1(u) gur		*ša ba-li-ṭa* santana
36			*i-*	*na ṭup-pi la in-nam-ru*$^!$
37		uru$_4$ en	si$_2$	e$_2$ ^{d}nanna *ša ma-la i-li-a-am*
38		uru *kur-*⸢*ḫi-*	*a-*⸣*nu-*	*um*^{ki}
39		nig$_2$ e$_2$-gal […	]	
40	9(bur$_3$) 1(eše) 1(aš)	4(geš$_2$) 1(u) 4(aš) 2(bariga) 1(ban$_2$) 3(diš) 2/3 ⸢x⸣	⸢sila$_3$$^?$⸣[…]	gu$_2$-un uru$_4$ ensi$_2$ e$_2$ ^{d}nanna
41	4(bur’u) 2(bur$_3$) 2(eše)	1(geš’u) 2(geš$_2$) 5(u) 2(aš) 4(bariga) 4(ban$_2$) 3(diš)	1/3 5(u)[…a-]	ša$_3$ *ni-di-it* ^{d}nanna uru$_4$ lu$_2$-didli
42	4(u) sar	ša$_3$<-ba> 5(geš$_2$) 1(u) 6(aš) 4(bariga) 1(ban$_2$) 8(diš) ⸢sila$_3$⸣		aga-uš^{meš}
43	5(bur’u) 2(bur$_3$) 1(aš)/4(u)	1(geš’u) 7(geš$_2$) 7(aš) 1(bariga) 5(ban$_2$) 6(diš) 2/3	⸢ x x⸣	gu$_2$-un u$_3$ nig$_2$-gal$_2$-la
44	kaskal	ša$_3$<-ba> 5(geš$_2$) 1(u) 6(aš) 4(bariga) 1(ban$_2$) ⸢8(diš)⸣[sila$_3$]	[…]	uru$_4$ aga-uš^{meš}
45		nir-	da⸢ki⸣	
UpE				
46	4(bur$_3$) 4(aš)	1(geš$_2$) 2(u) 4(aš) 2(bariga) 1(ban$_2$) 3(diš) 1/3	2(bur$_3$) 1(aš)	gu$_2$-un nig$_2$-šu *ṣi$_2$-bu-ru-*/ir$_3$$^?$
47	2(eše) 5(aš)	2(u) 5(aš) 3(bariga) 5(ban$_2$) 3(diš) 1/3		nig$_2$-gal$_2$-la nig$_2$-kud šu-ri-a
48	5(bur$_3$) 3(aš)	1(geš$_2$) 5(u) 1(bariga) 6(diš) 2/3	2(bur$_3$) 1(aš)	uru *kur-ḫi-a-nu*
49	nig$_2$-šu ^{d}nanna			
LeE				
50	iti sig$_4$-a u$_4$ 2(u)-kam mu bad$_3$ ma$_2$-ri$_2$^{ki}			

Translation

	1	2	3	4
Obv				
1	controller, estimated yeild of the fields of the *rēdû* (and) additional payments			
2	property of the palace and property of the temple of Nanna (around) Nirda and *al-kurḫiānu*[ki]			
3	furrowed fields	its grain	furrows no grain	its name
4	1 *bur'u* 4 *bur* 1 *eše* 2 *iku* 5	4×60+12 *gur* 4 *bariga* 2 *ban* 2 2/3	1 *bur* 1 *eše* 2 *iku*	of the *rēdû* who stood for his father
5	among this	19 *gur* 2 *bariga* 5 *ban* 5		to sow, the farmer
6	1 *bur'u* 1 *eše* 5 *iku*	2×50+36 *gur* 5 *ban*	1 *bur* 2 *eše* 4 *iku* 1×60+10	of the *rēdû* instead of the dead and runaway men
7	among this	30 *gur* 4 *bariga* 1 *ban*		to sow, the farmer
8	8 *bur* 5 sar	2×60+13 *gur* 1 *bariga* 1 *ban* 1 *sila*	1 *bur* 1 *eše* 4 *iku*	of the dead and runaway men
9	among this	12 *iku* 2 *bariga* 3 *ban*		to sow, the farmer
10	1 *bur* 2 *eše* 5 *iku*	41 *gur* 3 *ban* 3 1/3 sila		the scribe *Zababa-nāṣir*
11	3 *bur'u* 5 *bur*	9×60+43 *gur* 1 *bariga* 5 *ban*	4 *bur* 2 *eše* 4 *iku*	the *rēdû*, goods of *Uraš-muballiṭ*
12	10 sar	7 *sila*	1×60+10	
13	among this	1×60+2 *gur* 4 *bariga* 3 *ban* 5 *sila*		to sow, the farmer
14	1 *eše*	3 *gur* 1 *bariga* 4 *ban*		the dead men, to sow, *Uraš-muballiṭ*
15	4 *iku*	3 *gur* 3 *bariga* 4 *ban* 5	of	the men of fees to sow, household of its controller
16				and *Zikir-ilīšu*
17	1 *eše* 4 *iku*	7 *gur* 2 *ban* 5		property of *Inbuša*
18	3 *bur'u* 5 *bur*	9×60+50 *gur* 2 *bariga* 2 *ban* 2 *sila*	4 *bur* 2 *eše* 4 *iku*	among the ration fields
19	1 *eše* 4 *iku* 10		1×60+10	the *rēdû*
20	among this	1×60+6 *gur* 3 *bariga* 2 *ban*		to sow, the farmer
loE				
21	8 *bur* 3 *iku*	2×60+18 *gur* 2 *bariga* 2 *ban* 1 2/3 $sila_3$		of additional payments
Rev				
22	1 *bur'u* 5 *bur* 2 *eše*	3×60+27 1 *ban* 6 2/3	[	fie]ld, unimproved land of the palace,
23	4 *iku* 1(u)	to sow	x x	half yield
24		among this 1 *gur* 1 *bariga* 1 *ban* 5		to sow, the farmer
25	5 *bur'u* 9 *bur*	10×60+5×60+36 *gur* 1/3 *sila*	8 *bur*	palace property
26	1 *eše* 5 *iku* 20			
27		among this 1×60+7 *gur* 4 *bariga* [3 *ban*] 5 *sila*		rent, to sow, the farmer of the temple of Nanna
28		18 *gur* 4 *bariga* 2+ *ban*	instead of	her father stood
29		grain-*gur* […]	instead of	the dead and runaway men stood
30		1×60+58 *gur* 4 *bariga* […]	4 2/3	of the dead men
31		to sow,	*Uraš-muballiṭ*	
32		Nirda […]		

33	5 *bur* 1 *eše*	1×60+8 *gur* 4 *bariga* 2 *ban* 6 2/3	1 *bur* 3 *iku*	*rēdû*, property of *Iddin-Lagamal*
34		among this 41 3 *bariga* 4 *ban* 3 1/3 *sila*		to sow, the farmer of the temple of Nanna
35	2 *bur* 1 *eše*	1×60+10 gur		of *Baliṭa* gardener
36				not read from the tablet
37		To sow, the	farmer	as much as is able.
38		*al-Kurḫiānum*		
39		property of the Palace […	]	
40	9 *bur* 1 *eše* 1 *iku*	4×60+14 *gur* 2 *bariga* 1 *ban* 3 2/3x	*sila*$^{?}$ […]	rent, to sow, the farmer of the temple of Nanna
41	4 *bur'u* 2 *bur* 2 *eše*	10×60+2×60+52 4 *bariga* 4 *ban* 3	1/3 5 *bur* […]	[fi]eld, the unimproved land of Nanna, to sow, individual men
42	40 *sar*	among this 5×60+16 *gur* 4 *bariga* 1 *ban* 8 *sila*		*rēdû*
43	5 *bur'u* 2 *bur* 1 *iku* 40	10×60+7×60+7 *gur* 1 *bariga* 5 *ban* 6 2/3	x x	rent and property
44	road	among this 5(geš$_2$) 1(u) 6(aš) 4 *bariga* 1 *ban* 8 [*sila*]	[…]	to sow, *rēdû*
45		Nir-	da	
UpE				
46	4 *bur* 4 *iku*	1×60+24 *gur* 2 *bariga* 1 *ban* 3 1/3	2 *bur* 1 *iku*	rent, property of *Ṣiburu-warad*
47	2 *eše* 5 *iku*	25 *gur* 3 *bariga* 5 *ban* 3 1/3		possession, half yield
48	5 *bur* 3 *iku*	1×60+50 *gur* 1 *bariga* 6 2/3	2 *bur* 1 *iku*	*al-Kurḫiānu*
49	property of Nanna			
LeE				
50	Month 6, day 20, year the wall of Mari (*Hammu-rābi* year 35)			

Notes

2 For nir-da^{ki} see Groneberg (1980: 180). It appears in UET 5, 589: 4 (with uru^{ki}); UET 5, 857: 11; and UET 5, 883: 2. For uru *kur-ḫi-a-nu*, see *ibid.*: 146 and UET 5, 857, 7. Because of the reference to place names found in the Ur Excavation Texts, this document may have originated or referred to transactions near the city of Ur.

5, 7, 9, 10, 14 Note a thumbnail impression on these five lines before grain quantities but located in column 1.

6 Collation revealed this to be 2(aš), the remains of 4(aš), rather than 3(aš), the remains of 5(aš).

22, 41 In line 22, the sign is either a simple ‘a’ or the remains of a ‘$\check{s}a_3$’ sign. Similarity with line 41’ suggests the later. Unfortunately there is a break in both lines just before this sign so that it is unclear whether this refers to ‘$\check{s}a_3$’, which would translate to ‘among’, or ‘[a-]$\check{s}a_3$’, which is translated here as ‘fields’

27 Collation revealed the tablet reads 7(aš) and not 9(aš).

34 The final two signs are covered over by an erasure.

36 Final ‘di’ is probably a mistake for ‘ru’—the author omitted a couple wedges—rendering this the phrase, ‘*ṭ. amāru*’ (see Black et al. 2000, 415).

46 Reading of this personal name is uncertain.

Ashm 1922-281
CDLI number: P347353
Copy: Dalley 2005: no. 010

Date formula: *Rīm-Sîn* of Larsa year 01 (1822 BCE), month 09, day 14.

Ashm 1922-281 describes labor and grain allocations under the authority of various foremen. It is a list in tabular array stating first a quantity of men (column 1), then a quantity of grain (column 2) and finally a foreman (column 3) to whom these resources are allocated. Total men and then grain appear in line 32. The text itself is attributed to *Nabi-Šamaš* the conveyor and perhaps a local merchant contractor to the bureau of irrigation and excavation (Appendix 2.J). However, the personal name in line 34, *Mašrum-turam*, would appear to be the authority charged with the men and grain in the preceding lines and is possibly a canal contractor overseeing canal maintenance.

There are two main problems when interpreting this text. First, the subtotal in line 24 is off by 6. This discrepancy is carried into line 32’s total, which is further off by 1. It shows $8 \times 60 + 59$ rather than the expected $8 \times 60 + 58$. In addition, the total grain in line 30 does not match the extant contents of the text as understood here due to a break at the ends of lines 19 through 24. Second, ‘$i\check{s}_3$’ appears in line 24. It is difficult to tell whether this symbol is a quantity or not, but it does not seem to belong to either men or grain. Perhaps it is the traces of an erased line. The answer to these two problems may have once lied in the break of lines 17 through 25.

Transliteration

Obv	1	2	3
1	erin$_2$	še	mu-bi-im
2	3(u) 7(diš)	1(aš) 2(bariga) 1(ban$_2$)	^{d}adad-*šar-rum*
3	2(u) 5(diš)*	1(aš) 1(ban$_2$)	*a-wi-il-i*$_3$*-li*$_2$
4	1(u) 6(diš)	3(bariga) 4(ban$_2$)	ušu$_3$-*im-gur-an-ni*
5	1(u) 1(diš)	2(bariga) 5(ban$_2$)	*aš-rum-a-ša-mar*
6	1(u)	2(bariga) 4(ban$_2$)	*na-bu-tum*
7	1(geš$_2$) 5(diš)	2(aš) 1(bariga) 5(ban$_2$)	^{d}en-lil$_2$-*na-ṣir*
8	1(diš)	1(bariga) še	*na-ap-lu-us-*^{d}⸢x x x⸣
9	1(u) 6(diš)	2(bariga) 4(ban$_2$)	*šu-mu-li-ib-ši*
10	1 me 1(geš$_2$) 2(u) 1(diš)*	7(aš) 2(bariga)	erin$_2$ a-ab-ba
11	4(u)	2(aš) 3(bariga) 2(ban$_2$)	*ḫa-ab-li-ia*
12	4(u)	2(aš) 3(bariga) 2(ban$_2$)	*ḫu-za-lum*
13	4(u)	2(aš) 3(bariga) 2(ban$_2$)	dingir-*šu-ib-rum*^{ki}
14	1(diš) me 2(u)	8(aš)	erin$_2$ *ḫa-pi*$_2$*-ru*
15	1(u) 5(diš)	2(bariga) 3(ban$_2$)	*nu-ur*$_2$-^{d}*Ištar*-tuk
16		2(bariga) 3(ban$_2$)	erin$_2$ elam^{ki}
17	1(diš) me	3(aš) 2(bariga) 4(ban$_2$)	*ṭa*$_3$*-ab-*[…]
18	1(diš) me	3(aš)	erin$_2$ […]
19		2(bariga) [4(ban$_2$)	…]
20	1(geš$_2$) 1(u)	2(aš) ⸢2(bariga)*⸣[4(ban$_2$)]	…]
loE			
21		⸢1+(aš)⸣[…	…]
Rev			
22	3(u) 6(diš)	1(aš) ⸢1(bariga)⸣[…	…]
23		1(aš) 1(bariga)	⸢x⸣[…]
24	1(diš) me	3(u) 4(aš) 2(bariga)	ib$_2$ […]
25		bi$_2$ maš-⸢ša⸣	*i-na* uru ⸢x⸣[…]
26		*i-na* e$_2$	dingir-*ma-a-bi* ušu$_3$-apin ⸢x x⸣
27		4(aš) 2(bariga)	erin$_2$ šu-ku$_6$ larsa^{ki}
28		1(bariga) še	erin$_2$ *li-ib-bi*$_3$ U$_2$ ZAG IM TUM
29	2(u)	3(bariga) 2(ban$_2$)	erin$_2$ larsa^{ki} *zi-iš-an*
30	2(diš)	2(ban$_2$)	erin$_2$ uru ^{d}gu-la erin$_2$ uru *ša-aš*$_2$*-rum*
31	2(u) 2(diš)	3(bariga) 4(ban$_2$)	giri$_3$ e$_2$-a-*ma-lik*
32	8(geš$_2$)	2(u) 8(aš) 2(bariga)	šu-nigin
33	5(u) 9(diš)		
34	*ma-aš-rum-tu-ra-am* dumu *i-bi-*^{d}*šakkan*		
35	2(bariga) 3(ban$_2$) še ša$_3$ še *na-bi-*^{d}Šamaš ugula Amurru		
36	*a-na* ša$_3$-gal giri$_3$		
37	iti gan-gan-e$_3$ u$_4$ 14 kam$_2$		
UpE			
38	mu ^{d}*ri-im-*^{d}en-zu lugal		

Translation

Obv	1	2	3
1	Men	Grain	Its name
2	37	1 *gur* 2 *bariga* 1 *ban*	*Adad-šarrum*
3	25	1 *gur* 1 *ban*	*awīl-ilī*
4	16	3 *bariga* 4 *ban*	*Sîn-imguranni*
5	11	2 *bariga* 5 *ban*	*Ašrum-ašamar*
6	10	2 *bariga* 4 *ban*	*Nabūtum*
7	1×60+5	2 *gur* 1 *bariga* 5 *ban*	*Enlil-nāṣir*
8	1	1 *bariga* grain	*Naplūs-*^{d} x x x
9	16	2 *bariga* 4 *ban*	*Šumu-libšī*
10	100+1×60+21	7 *gur* 2 *bariga*	men of the sea
11	40	2 *gur* 3 *bariga* 2 *ban*	*Ḫabliya*
12	40	2 *gur* 3 *bariga* 2 *ban*	*Ḫuzalum*
13	40	2 *gur* 3 *bariga* 2 *ban*	*Ilšu-ibrum*
14	100+20	8 *gur*	migrant men
15	15	2 *bariga* 3 *ban*	*Nūr-Ištar-tuk*
16		2 *bariga* 3 *ban*	men of Elam
17	100	3 *gur* 2 *bariga* 4 *ban*	*Ṭāb-*[…]
18	100	3 *gur*	men of […]
19		2 *bariga* [4 *ban*	…]
20	1×60+10	2 *gur* 2+ *bariga* [4 *ban*	…]
LoE			
21		1+ *gur* […	…]
Rev			
22	36	1 *gur* 1 *bariga*[…	…]
23		1 *gur* 1 *bariga*	x[…]
24	100	iš$_3$ 4 *gur* 2 *bariga*	ib […]
25		bi$_2$ maš- ša	from *al*-x[…]
26		from the household of	*Ilīma-abī*, *Sîn-apin* x x
27		4 *gur* 2 *bariga*	fishermen of Larsa
28		1 *bariga* grain	men center of U ZAG IM TUM
29	20	3 *bariga* 2 *ban*	men of Larsa, *zišan*
30	2	2 *ban*	men of al-*Gula* men of al-*Šašrum*
31	22	3 *bariga* 4 *ban*	transport of *Ea-malik*
32	8×60+	28 *gur* 2 *bariga*	total
33	59		
34	*Mašrum-turam* son of *Ibbi-šakkan*		
35	2 *bariga* 3 *ban* grain among the grain of *Nabi-Šamaš* overseer of the Amorites		
38	as fodder, conveyer		
37	month 9 day 14		
UpE			
38	year *Rīm-Sîn* is king (*Rīm-Sîn* year 1)		

Notes

3 Collation revealed this entry in column 1 to be 2(u) 5(diš) and not 6(diš).
10 Collation revealed 1(diš) at the end of the entry in column 1.
14 Much ink has been spilled over the meaning of *ḫapiru*. Llop and George (2001/2002: 18) translate this word as 'Auslände'. Durand's understanding (1998: 374, 375) is followed here, 'il signifie «émigré» ou «immigré» selon les cas'. This definition is followed also by Fleming (1998: 74). Thus, the translation is 'migrant' here.
20 Collation revealed the possibility of 2(bariga) plus what is broken, whether one or two more bariga, or something else.
30 for uru ^{d}gu-la see Groneberg (1980: 11); for uru *ša-aš*$_{2}$*-rum* see perhaps *ibid.*: 220, *Šašran.*

Ashm 1923-340
CDLI number: P347464
Copy: Dalley 2005: no. 121
Edition: Robson 2014: text 36[6]
Collation, 8 April 2014

Date formula: *Hammu-rābi* of Babylon year 35 (1758 BCE), month 03, day 22.

Ashm 1923-340 is a tabular text attributed here to scribe P of the grain production archive (Appendix 2.GG) and possibly records activity around Ur based on the temple name in line 2. The text itself, dated to *Hammu-rābi*'s 35th year, offers estimations of yields on both palace and temple property and not actual yields. This is stated as such in line 1 with the appearance of *šukunnû*, 'estimated yield'. Yields themselves, which are probably described in columns 2 and 6, seem artificial. In line 8, 1(u) translates to 10 (*gur*), which has a SPVN transformation of 50. In lines 9–10 and 14 through 16, 3(u) translates to 30 (gur), which has an SPVN transformation of 2:30. In lines 11 and 17 through 19, 2(u) translates to 20 (*gur*) with a SPVN transformation of 1:40. It therefore seems likely that line 7 is a simple mistake—the author wrote 3(u), perhaps in anticipation of line 9, rather than 1(aš). Four rates are seen in the text when calculated in SPVN: 5 parts grain per part land in line 7, 50 parts grain per part land in line 8, 2:30 parts grain per part land in lines 9–10 and 14 through 16, and 1:40 parts grain per part land in lines 11 and 17 through 19. Thus, for instance, in line 9, every *sar* land was expected to produce 2 1/2 *sila*, every 1 *ubu* 10 *sar* land produced 4 *bariga* 10 *ban* grain, every *bur* produced 15 *gur* grain, and every 2 *bur* produced 30 *gur* grain. The yield rates in columns 2 and 4, then, are based on every 2 *bur*, not 1 *bur* so that they are probably not based on land units at *bur*, but on the number 1 in SPVN. 1 in SPVN transforms into 2 *bur* while yield is defined as a rate in *gur* and so could only be defined by this magnitude for measurement values in columns 1 and 3 to correspond to measurement values in columns 3 and 7. Measurement value choice suggests that the basis for calculation is SPVN.

[6]For transliteration and translation, see Robson (2014: OECT 15, 121 [tabular account]), http://oracc.museum.upenn.edu/obta/P347464/html. Accessed 30 June 2018.

Obv.	1	2	3	4	5	6	7	8	9
1	*šu-ku-un-na* a-gar$_3$ a-a-ni-a-tum *u*$_3$ a-gar$_3$ dam-la-ga-nu								
2	a-ša$_3$ e$_2$ ^{d}nanna *u*$_3$ aga-uš^{meš} *ša* ab-sin$_2$ *iš-ta-ad-du*								
3	uru šu-un-na-mu-un-dim$_2$^{ki}								
4	gu$_2$ i$_7$ *ri-bi-an-na* bal-re *a-a-bi*								
5	ab-sin$_2$	gar-gar	še-bi	še-nu	ab-sin$_2$	gar-gar	še-bi	še-nu	mu-bi-im
6	nig$_2$		e$_2$		gal nig$_2$	e$_2$	^{d}nanna		
7					1(bur$_3$) 2(aš)	3(u)	3(u) 3(aš) 1(bariga) 4(ban$_2$)		eš$_2$-gar *i-din-*^{d}Šamaš ensi$_2$ *ša ma-la i-li-a-am ša-ak-nu*
8	3(aš)	1(u)	4(bariga) 1(ban$_2$)		3(aš)	1(u)	4(bariga) 1(ban$_2$)		ki 1
9	1(eše) 4(aš)	3(u)	8(as) 1(bariga) 4(ban$_2$)		1(eše) 4(aš)	3(u)	8(as) 1(bariga) 4(ban$_2$)		ki 2 *ap-lum* dumu *a-ḫu-um*
10	5(aš)	3(u)	4(aš) 5(ban$_2$)		5(aš)	3(u)	4(aš) 5(ban$_2$)		*i-din-*^{d}Sîn šakan$_6$ *ki-ip-ra-am*^{ki}
11	1(u) 5(diš)	2(u)	2(ban$_2$) 5(diš)		1(u) 5(diš)	2(u)	2(ban$_2$) 5(diš)		*a-ḫ a-mar-ši*$_2$ *na-ap-pi*$_2$*-lum*
12	1(aš) 1(geš$_2$) 2(u)	3(u)	1(aš) 2(bariga) 3(ban$_2$)		1(aš) 1(geš$_2$) 2(u)	3(u)	1(aš) 2(bariga) 2(ban$_2$)^{sic}		*nu-rum-li-ṣi* lu$_2$ šu-na-nu-un-dim$_2$^{ki}
13	1(aš) 2(u)	3(u)	1(aš)		1(aš) 2(u)	3(u)	1(aš)		^{d}Sîn-sipa *u*$_3$ ^{d}Sîn-dam-gar$_3$-*ri*
14	2(aš)	3(u)	1(aš) 3(bariga) 2(ban$_2$)		2(aš)	3(u)	1(aš) 3(bariga) 2(ban$_2$)		*be*$_2$*-e-ta-a u*$_3$ ^{d}Sîn-*ma-gir*
15	1(eše) 1(aš) 1(ubu)	3(u)	6(aš) 1(bariga) 1(ban$_2$) 5(diš)		1(eše) 1(aš) 1(ubu)	3(u)	6(aš) 1(bariga) 1(ban$_2$) 5(diš)		*i*$_3$*-li*$_2$*-i-di-nam* nu-banda$_3$ lu$_2$ šu-na-nu-un-dim$_2$^{ki}
16	3(aš)	3(u)	2(aš) 2*(bariga) 3(ban$_2$)		3(aš)	3(u)	2(aš) 2(bariga) 3(ban$_2$)		*a-wi-il-*^{d}adad *u*$_3$ *a-pil-*^{d}Amurru
17	erasure				1(eše) 1(aš) 1(ubu)	2(u)	4(aš) 5(ban$_2$)		uru$_4$ ^{d}Sîn-[…]
LoE									
18					1(eše)	2(u)	3(aš) 1(bariga) 4(ban$_2$)		uru$_4$ *ṣi-li-*[…]
19	1(bur$_3$) 1(aš) 1(ubu)	2(u)	1(u) 4(bariga) 1(ban$_2$)						uru$_4$ *na-rum-*⸢*li*⸣-[*ṣi*]
Rev									
20					1(bur$_3$) 2(aš)		3(u) 3(aš) 1(bariga) 4(ban$_2$)		eš$_2$-gar$_3$ ^{d}nanna *ša* gal-⸢x-x⸣
21	2(bur$_3$) 2(eše) 5(aš)		3(u) 7(aš)		2(bur$_3$) 1(eše) 4*(aš)		3(u) 1(aš)^{sic}		uru$_4$ lu$_2$ didli nig$_2$-kud šu-ri-a
22	1(u) 5(diš)		*1(bariga)		1(u) 5(diš)		4(bariga) 1(ban$_2$)		

23					2(bur$_3$) 2(eše)		1(geš$_2$) 2(aš)		nig$_2$ e$_2$ ^{d}nanna
24					5(aš) 1(geš$_2$) 5(diš)		1(bariga)* 4(ban$_2$)*		
25	a-gar$_3$ a-a-ni-a-tum *u$_3$* a-gar$_3$ dam-la-ga-nu-um								
26	uru *šu-un-na-mu-un*-dim$_2^{ki}$								
27	giri$_3$ ^{d}Šamaš-*ḫa-zi-ir* ^{d}Marduk-*na-ṣir* *u$_3$* ša$_3$-tam^{meš}								
28	iti sig$_4$-a u$_4$ 2(u) 2(diš)-kam$_2$								
29	mu *ḫa-am-mu-ra-bi* lugal-e								
30	bad$_3$ ma-ri^{ki} *u$_3$* ma$_3$-al-gi-a^{ki}								
31	mu-un-gul-la								

Translation

Obv.	1	2	3	4	5	6	7	8	9
1	Estimated yield of the meadow of *Ayyaniatum* and the meadow of Dam-laganu								
2	field of the temple of Nanna and the *rēdû* who had surveyed the furrows								
3	*Al-šunnamundim*								
4	The mouth of the *Ribi-anna* canal other side of the enemy								
5	furrowed	addition	its grain	no grain	furrow	addition	its grain	no grain	its name
6	property of		the palace		property of	the temple	of Nanna		
7					1 *bur* 2 *iku*	30 (*gur*$^{?}$)	33 *gur* 1 *bariga* 4 *ban*		Work assignment of *Iddin-Šamaš*, farmer, as much as is able is imposed
8	3 *iku*	10 (*gur*)	4 *bariga* 1 *ban*		3 *iku*	10 (*gur*)	4 *bariga* 1 *ban*		place 1
9	1 *eše* 4 *iku*	30 (*gur*)	8 *gur* 1 *bariga* 4 *ban*		1 *eše* 4 *iku*	30 (*gur*)	8 *gur* 1 *bariga* 4 *ban*		place 2 *Aplum* son of *Aḫum*
10	5 *iku*	30 (*gur*)	4 *gur* 5 *ban*		5 *iku*	30 (*gur*)	4 *gur* 5 *ban*		*Iddin-Sîn* governor of *kipram*
11	15	20 (*gur*)	2 *ban* 5		15	20 (*gur*)	2 *ban* 5		*Aḫa-māršī* accountant
12	1 *iku* 1×60+20	30 (*gur*)	1 *gur* 2 *bariga* 3 *ban*		1 *iku* 1×60+20	30 (*gur*)	1 *gur* 2 *bariga* 2 *ban*		*Nūrum-liṣi* the *šunnanundim*-ite
13	1 *iku* 20	30 (*gur*)	1 *gur*		1 *iku* 20	30 (*gur*)	1 *gur*		*Sîn-rē'î* and *Sîn-tamkārī*
14	2 *iku*	30 (*gur*)	1 *gur* 3 *bariga* 2 *ban*		2 *iku*	30 (*gur*)	1 *gur* 3 *bariga* 2 *ban*		*Bêtâ* and *Sîn-magir*
15	1 *eše* 1 *iku* 1 *ubu*	30 (*gur*)	6 *gur* 1 *bariga* 1 *ban* 5		1 *eše* 1 *iku* 1 *ubu*	30 (*gur*)	6 *gur* 1 *bariga* 1 *ban* 5		*Ilī-iddinam*, supervisor, the *šunnanundim*-ite

16	3 *iku*	30 (*gur*)	2 *gur* 2 *bariga* 3 *ban*		3 *iku*	30 (*gur*)	2 *gur* 2 *bariga* 3 *ban*		*Awīl-Adad* and *Apil-Amurru*
17					1 *eše* 1 *iku* 1 *ubu*	20 (*gur*)	4 *gur* 5 *ban*		to sow, *Sîn*-[…]
LoE									
18					1 *eše*	20 (*gur*)	3 *gur* 1 *bariga* 4 *ban*		to sow, *Ṣillī*-[…]
19	1 *bur* 1 *iku* 1 *ubu*	20 (*gur*)	10 *gur* 4 *bariga* 1 *ban*						to sow, *Nurum-li*[*ṣi*]
Rev									
20					1 *bur* 2 *iku*		33 *gur* 1 *bariga* 4 *ban*		work assignment of Nanna
									which gal-x-x
21	2 *bur* 2 *eše* 5 *iku*		37 *gur*		2 *bur* 1 *eše* 5 *iku*		31 *gur*		to sow, individual men, half the yield
22	15		1 *bariga*		15		4 *bariga* 1 *ban*		
23					2 *bur* 2 *eše*		1×60+2 *gur*		Property of the temple of Nanna
24					5 *iku* 1×60+5		1[?] *bariga* 4[?] *ban*		
25	meadow of *Ayyaniatum* and the meadow of Dam-laganu								
26	*Al-šunnamundim*								
27	transport of *Šamaš-ḫāzir*, *Marduk-nāṣir* and the *šatammu*								
28	Month 3 day 22								
29	Year *Hammu-rābi*, the king								
30	the walls of Mari and Malgium								
31	Destroyed (*Hammu-rābi* year 35)								

Notes

7 1(aš) is expected rather than 3(u) in column 6.

11 *na-ap-pi$_2$-lum* is possibly derived from the verb *napālum*, 'to pay, balance', and refers to an accountant of some sort.

12 3(ban$_2$) is expected in column 7 rather than 2(ban$_2$) visible on the copy and tablet, based on column 3. This works well with the total rendering it likely that line 12 column 7 is a simple epigraphic mistake.

16 Column 3 reveals 2(bariga) on the tablet rather than 1 (bariga) on the copy.

21 Column 5 shows an additional winkelhaken above 1(eše), probably a poorly written aš sign which would make the expected 5(aš).
Column 7 should read 3(aš) instead of 1(aš) for the total to be correct. It must represent a mistake.

22 Traces of a prior writing appear in column 3 so that 1(bariga) is probably written over an erasure. Perhaps the scribe started to write 5(ban$_2$) and then decided to round up.

24 The signs in column 7 are difficult and reading is uncertain. They are perhaps traces left of a lower value to the total in line 23 after erasure or the author wrote a new value over an old sign, perhaps correcting a mistake.

LB 1075
CDLI number: P389506
Copy: Leemans 1964: no. 55
Edition: Leemans 1954: no. 55
Collation: 06 March 2014

Date formula: *Rīm-Sîn* of Larsa year 39 (1784 BCE), month 03, day 15.

LB 1075, attributed to the archive of a notable named *Sîn-iddinam* (Appendix 2.BB), is of uncertain provenance, although it may be from around or north of Larsa based on place names. This text is a tabular balanced account on which capital and expenditures are stated for two localities and the difference between the two, stated as a balance, is calculated. Both capital and expenditures take the form of *bappiru* and then salt. Salt is interestingly provided a change rate in the capital section, understood here as difference produced by sample remeasurement of 1 *gur* salt.

Transliteration

Obv	1	2	3
1	bappir	mun	mu-bi-im
2	2(aš) 3(ban$_2$) gur	5(aš) 4(bariga) 2(ban$_2$) gur	uru^{ki} eš$_3$-nun-na^{ki}
3		sag-bi$_2$ la$_2$* 3(bariga) 2(ban$_2$) 5(diš) *ša i-na* 1(aš) gur 3(ban$_2$) 5(diš) sila$_3$-ta-am$_3$	
4			*i-wa-ṣa-bu*
5		2(bariga)	nig$_2$-šu ^{d}nanna-ma-an-si$_3$
6	uru^{ki}	*di-ni-ik-tum*	
7	2(aš) 3(ban$_2$)	6(aš) 4(bariga) 4(ban$_2$) 5(diš) sila$_3$ gur	
8	sag-<nig$_2$>-gur$_{11}$-ra	⸢ša$_3$⸣[-bi]-ta	
9	2(bariga) 9(diš)	1(aš) 3(bariga) ⸢3(ban$_2$)⸣[gur]	⸢uru⸣^{ki} *di-ni-ik-tum* […]
10	1(bariga) 4(diš)	4(bariga)	uru^{ki} *di-ni-*⸢*ik-*⸣[*tum*…]
Rev			
11	3(bariga) 1(ban$_2$) 3(diš)	2(aš) 2(bariga) 3(ban$_2$) gur	[…]
12	šu-ti-a ^{d}nanna-ma-⸢an⸣-si$_3$]	x [	…]
13	*si-*	*i$_3$*-[	*tum*]
14	1(aš) 2(bariga) 1(ban$_2$) 7(diš)	4(aš) 2(bariga) 1(ban$_2$) 5(diš) sila$_3$	[…]
15		iti sig$_4$-a u$_4$ 1(u) 5(diš)-kam	
16		mu ki 1(u) *i$_3$-si-in*^{ki}	
17		ba-an-dib$_2$	

Translation

Obv	1	2	3
1	*bappiru*	salt	its name
2	2 *gur* 3 *ban*	5 *gur* 4 *bariga* 2 *ban*	*Al*-Ešnunna
3		its principal checked, 3 *bariga* 2 *ban* 5 which among 3 *ban* 5 *sila* per 1 *gur*	

4			he adds
5		2 *bariga*	Property of *Sîn-iddinam*
6	*Al-*	*Diniktum*	
7	2 *gur* 3 *ban*	6 *gur* 4 *bariga* 4 *ban* 5 *sila*	
8	capital	out of which	
9	2 *bariga* 9 (*sila*)	1 *gur* 3 *bariga* 3 *ban*	*Al-Diniktum* […]
10	1 *bariga* 4 (*sila*)	4 *bariga*	*Al-Dinik*[*tum*…]
Rev			
11	3 *bariga* 1 *ban* 3	2(aš) 2 *bariga* 3 *ban* gur	[…]
12	receipt of *Sîn-idinn*[*am*		…]
13	*ba-*	*la-*[	*nce*]
14	1(aš) 2 *bariga* 1 *ban* 7 (*sila*)	4(aš) 2 *bariga* 1 *ban* 5 *sila*	[…]
15		month 4 day 15	
16		Year 10 Isin	
17		was seized (*Rīm-Sîn* year 39)	

Notes

1 Sumerian bappir is difficult to translate but is here understood as an ingredient possibly a form of coarsely ground barley, used in the production of beer. For more on this word, see Damerow (2012: Sect. 4).
3 The understanding 'its principal checked' is from a reading 'sag-bi$_2$ la$_2$' its principal + weighed, which is confirmed on collation and against Leemans' reading SAG-NE-ME, which he did not understand.
6 For uru^{ki} *di-ni-ik-tum*, see Groneberg (1980: 54), where it is equated with Tell Hurma near modern Baghdad. Goetze (1964: 115) equates it with Tall Muḥammad near Tell Ḥarmal. See also George (1993: 96, entry 426) where it is listed with the e$_2$-gu-la of *Diniktum*. See also Reiner (1974: 228, 235) where *Diniktum* is first mentioned in the Nanāy Hymn (p. 228, line 42) and then discussed by Reiner on page 235 under *Strophe* XV.

NBC 06763
CDLI number: P289615
Copy: Middeke-Conlin 2018: 291
Edition: Middeke-Conlin 2018: 286, 287

Date formula: *Rīm-Sîn* of Larsa year 38 (1785 BCE), month 11, day 8.

NBC 06763, dated to *Rīm-Sîn* 38th year in power and associated with *Immer-ilī* (Appendix 2.AA), is an unprovenanced tabular text concerning the excavations of a series of canal sections. It is divided into five columns: column 1 states length, column 2 states width, column 3 states depth, column 4 states volume, while column 5 provides a label for each canal section. The last two entries on this side do not state dimensions, only volume. Unlike NBC 11509, all dimensions, including width, vary between canal sections. An administrative summary follows the total in line 10, which states who is charged with and who is responsible for the excavation (Middeke-Conlin 2018: 285).

Transliteration

Obv.	1	2	3	4	5
1	us$_2$	dagal	bur$_3$-u	saḫar	
2	7(diš) ninda 1/2 kuš$_3$	2(diš) ninda 4(diš) kuš$_3$	1/2 ninda 2(diš) 1/2 kuš$_3$	1(aš) iku 3(u)8(diš) 5/6 sar	ki 1(diš)
3	1(diš) ninda 4(diš) kuš$_3$	2(diš) 1/2 ninda	1/2 ninda 1(diš) 1/2 kuš$_3$	2(u) 5(diš) sar	ki 2(diš)
4	7(diš) ninda	2(diš) 1/2 ninda 5(diš) 1/3 kuš$_3$	1/2 ninda 2(diš) 1/2 kuš$_3$	1(aš) 1(ubu) iku 2(u) 6(diš) / 1/2 sar 6(diš) 2/3 gin$_2$	ki 3(diš)
5	3(diš) ninda 1(diš) kuš$_3$	2(diš) 1/2 ninda 3(diš) 1/3 kuš$_3$	1/2 ninda 1(diš) kuš$_3$	1(ubu) iku 9(diš) 1/2 sar	ki 4(diš)
6	1/2 ninda 2(diš) kuš$_3$	2(diš) 1/2 ninda 3(diš) 1/3 kuš$_3$	1/2 ninda 1(diš) kuš$_3$	1(u) 3(diš) sar 6(diš) 2/3 gin$_2$	ki 5(diš)
7 8 9				6 sar 1(u)	ki 6(diš) *ša i-na li-ib-bi* i$_7$-da *in-na-as-ḫu*
10 11				8 sar *ša i-na u$_2$-ša-la-tim* [x x] ⸢x x⸣	ki ⸢7(diš)⸣
Rev					
12 13				4(aš) iku 26 sar 10 gin$_2$	saḫar i$_7$ *ma-*⸢*lik*?⸣- er$_3$-ra
14	1(diš) 1/2 ninda 4(diš) 2/3 kuš$_3$	1/2 ninda 3(diš) kuš$_3$	1/2 ninda 5(diš) kuš$_3$	15 sar 10 gin$_2$	saḫar i$_7$ ^{d}en-⸢lil$_2$⸣- [...]
15			šu-nigin	4(aš) iku 41 1/3 sar	saḫar
16	i$_3$-dab$_5$			Nin-ki-aĝ$_2$-^{d}	Adad-ra
17	nig$_2$			*im-me-er-*	dingir
18 19 20	iti udru (ZIZ$_2$.A) u$_4$ 8-kam mu ki-9 i$_3$-si-in-na^{ki} ^{d}en-ki-ga-ta ba-an-dab$_5$				

Translation

Line	1	2	3	4	5
Obv 1	length	width	depth	volume	
2	7 *ninda* 1/2 *kuš*	2 *ninda* 4 *kuš*	1/2 *ninda* 2 1/2 *kuš*	1 *iku* 38 5/6 *sar*	place 1
3	1 *ninda* 4 *kuš*	2 1/2 *ninda*	1/2 *ninda* 1 1/2 *kuš*	25 sar	place 2
4	7 *ninda*	2 1/2 *ninda* 5 1/3 *kuš*	1/2 *ninda* 2 1/2 *kuš*	1 *iku* 1 *ubu* 26 1/2 *sar* 6 2/3 *gin*	place 3
5	3 *ninda* 1 *kuš*	2 1/2 *ninda* 3 1/3 *kuš*	1/2 *ninda* 1 *kuš*	1 *ubu* 9 1/2 *sar*	place 4
6	1/2 *ninda* 2 *kuš*	2 1/2 *ninda* 3 1/3 *kuš*	1/2 *ninda* 1 *kuš*	13 *sar* 6 2/3 *gin*	place 5
7				6 *sar* 10	place 6
8				which from the canal	
9				was removed	
10				8 *sar*	place 7
11				which was in the meadows [has been …]	
Rev					
12				4 *iku* 26 *sar*	earth of the *Malik*-
13				10 *gin*	*Erra* canal
14	1 1/2 *ninda* 4 2/3 *kuš*	1/2 *ninda* 3 *kuš*	1/2 *ninda* 5 *kuš*	15 *sar* 10 *gin* earth of the Enlil-[…] canal	
15			total	4 *iku* 41 1/3 *sar*	volume
16	charge of			*Ninkiaĝ*-	*Iškura*
17	property of			*Immer*-	*ilī*
18	Month 11 day 8				
19	Year 9 (after) he seized Isin with				
20	Enki.(*Rīm-Sîn* year 38)				

Notes

3 1/2 in 1/2 kuš$_3$ of column 3 is written over an erased U$_2$.
8 gin$_2$ is expected after 10 in column 4.

NBC 11509
CDLI number: P293314
Copy: Middeke-Conlin 2018: 291
Edition: Middeke-Conlin 2018: 282

Date formula: *Rīm-Sîn* of Larsa$^{?}$ (1822-1763 BCE), month 11, day 01.

NBC 11509, produced by an unnamed scribe of the bureau of irrigation and excavation (scribe I, Appendix 2.V), is a tabular administrative text, probably from Larsa, that records an excavation. The obverse is divided into 5 columns stating length in column 1, width in column 2, and depth in column 3, the excavation's volume in column 4, and the section being excavated in column 5. Length and depth in each section vary while width is uniform. Total volume is stated in line 8. This is followed by an administrative summary, which describes the project: the banks of the *Mami-šarrat* canal, located in the south of the kingdom of Larsa connecting the Tigris and the Euphrates, are being consolidated. *Rīm-Sîn-rappašunu* is charged with canal maintenance (Middeke-Conlin 2018: 283).

Transliteration

Obv	1	2	3	4	5
1	gid$_2$	dagal	gam	saḫar	mu-⸢bi⸣[-im]
2	6(diš) ninda	4(diš) kuš$_3$	3(diš) 1/2 kuš$_3$	7(diš) sar	ki 1(diš)
3	6(diš) 1/2 ninda	4(diš) kuš$_3$	3(diš) 1/2 kuš$_3$	4(diš) sar 5(diš) gin$_2$	ki ⸢2(diš)⸣
4	1(u) 4(diš) 1/2 ninda	4(diš) kuš$_3$	3(diš) kuš$_3$	1(u) 4(diš) 1/2 sar	ki ⸢3(diš)⸣
5	5(diš) ninda	4(diš) kuš$_3$	3(diš) 1/2 kuš$_3$	5(diš) 5/6 sar	ki ⸢4(diš)⸣
6	2(u) 2(diš) ninda	4(diš) kuš$_3$	4(diš) kuš$_3$	2(u) 9(diš) 1/3 sar	ki ⸢5(diš)⸣
7	1(u) 7(diš) ninda	4(diš) kuš$_3$	4(diš) 1/2 ninda$^{!}$	2(u) 5(diš) 1/2 sar	ki 6(diš)
8			1(ubu) GAN$_2$	3(u) 6(diš) sar 1(u) 5(diš) gin$_2$	
9	saḫar *a-aḫ*	i$_7$ ^{d}*ma-mi-šar-ra-at ka-ṣa-ri-*[*im*]			
Rev					
10	i$_3$-dab$_5$ ^{d}*ri-im-*^{d}Sîn-*ra-ap-pa-šu-nu*				
11	iti udru (ZIZ$_2$.A) u$_4$ 1-kam				

Translation

	1	2	3	4	5
Obv					
1	length	width	depth	volume	[its] name
2	6 *ninda*	4 *kuš*	3 1/2 *kuš*	7 *sar*	place 1
3	6 1/2 *ninda*	4 *kuš*	3 1/2 *kuš*	4 *sar* 5 *gin*	place 2
4	14 1/2 *ninda*	4 *kuš*	3 *kuš*	14 1/2 *sar*	place 3
5	5 *ninda*	4 *kuš*	3 1/2 *kuš*	5 5/6 *sar*	place 4
6	22 *ninda*	4 *kuš*	4 *kuš*	29 1/3 *sar*	place 5
7	17 *ninda*	4 *kuš*	4 1/2 *kuš*!	25 1/2 *sar*	place 6
8			1 *ubu*	36 *sar* 15 *gin*	
9	Silt		to consolidate the bank of the *Mami-šarrat* canal		
Rev					
10	Charge of *Rīm-Sîn-rappašunu*				
11	Month 11	Day 1			

Notes

7 column 3, ninda must be a mistake for kuš$_3$ in order to produce volume in column 4.

9 For i$_7$ *ma-mi-šar-ra-at*, the *Mami-šarrat* canal, see Groneberg (1980: 296), Edzard (1987–1990: 329) and Owen (2013: 38 note 3). Groneberg (1980: 296) states of this canal, ‘Kanal, der Euphrat und Tigris mit dem Meer verbindet’. Edzard (1987–1990: 329) further states of this canal that it was ‘von Rīm-Sin von Larsa angelegt’. NBC 11509 probably refers to a subsequent dredging of this canal.

Riftin 1937: no. 116
Museum number: ERM—
CDLI number: P412598
Edition: Riftin 1937: 140, 141

Date formula: *Rīm-Sîn* of Larsa year 31 (1792 BCE), month 9, day –.

Riftin 1937: no. 116, attributed to scribe I of the bureau of irrigation and excavation (Appendix 2.V) and similar to Riftin 1937: no. 114, states costs in labor and then estimates the cost of this labor in grain by day and month using a tabular format. Divided into 6 columns, it lists the number of overseers (column 1), workmen (column 2), total laborers (column 3), total grain expended per day (column 4), total grain expended over a 30 period (column 5) and then the authority behind this labor (column 6). In addition, grain wage rates are stated in the headings for overseers and workmen.

Transliteration

Obv	1	2	3	4	5	6
1	erin$_2$ ugula *ša* 6(diš) 2/3	erin$_2$-ḫi-a *ša* 2(diš) sila$_3$	šu-nigin erin$_2$-ḫi-a	še-bi nig$_2$ u$_4$ 1 kam	šu-nigin še-bi nig$_2$ iti 1 kam	mu-bi-im
2	5(diš)	6(diš) me 1(geš$_2$) 7(diš)	6(diš) me 1(geš$_2$) 1(u) / 2(diš)	4(aš) 2(bariga) 4(ban$_2$) / 7(diš) 1/3 sila$_3$	2(geš$_2$) 1(u) 6(aš) / 3(bariga) 4(ban$_2$) gur	^{d}*ri-im*-^{d}en-[zu-*ra-pa* / *-šu-nu*]
3	2(diš)	6(diš) me 2(u) 1(diš)	6(diš) me 2(u) 3(diš)	4(aš) 5(ban$_2$) 5(diš) 1/3 sila$_3$	2(geš$_2$) 5(aš) 2(bariga) / 4(ban$_2$) gur	^{d}*ne*$_3$*-eri*$_{11}$*-gal-la-ma* / *-sa*$_3$-[*šu*]
4	1(diš)	6(diš) me 6(diš)	6(diš) me 7(diš)	4(aš) 1(ban$_2$) 8(diš) 2/3 sila$_3$	2(geš$_2$) 1(aš) 4(bariga) / 2(ban$_2$) ⸢gur⸣	*ša šar-ru-um i-ša* / -[*ka-nu*]
5	8(diš)	1(lim) 8 me 1(geš$_2$) 3(u) 4(diš)	1(lim) 9(diš) me 2	1(u) 2(aš) 4(bariga) 1(diš) 1/3 sila$_3$	6(geš$_2$) 2(u) 4(aš) 4(ban$_2$)	gur
6	erin$_2$				*si*$_2$*-ḫi-ir-ti*	e$_2$-gal

Rev	
7	iti gan-gan-e$_3$ ezem ^{d}*ne*$_3$*-eri*$_{11}$*-gal*
8	mu ki 2 ^{giš}tukul maḫ an ^{d}en-lil$_2$ ^{d}en-ki-ga-ta
9	*i*$_3$*-si-in*^{ki} uru^{ki} nam-lugal
10	*u*$_3$ a$_2$-dam didli a-na-me-a-bi
11	sipa zi ^{d}*ri-im*-^{d}Sîn
12	in-dab$_5$-ba

Translation

Obv	1	2	3	4	5	6
1	men, overseers of 6 2/3 (*sila*)	men of 2 *sila*	total men	Its grain, stuff of 1 day	total its grain stuff of 1 month	Its name
2	5	6 hundred 1×60+7	6 hundred 1×60 12	4 *gur* 2 *bariga* 4 *ban* 7 1/3 *sila*	2×60+16 *gur* 3 *bariga* 4 *ban*	*Rīm-Sî*[*n-rappašunu*]
3	2	6 hundred 21	6 hundred 23	4 *gur* 5 *ban* 5 1/3 *sila*	2×60+5 *gur* 2 *bariga* 4 *ban gur*	*Nergal-lamassa*[*šu*]
4	1	6 hundred 6	6 hundred 7	4 *gur* 1 *ban* 8 2/3 *sila*	2×60+1 *gur* 4 *bariga* 2 *ban gur*	which the king

						im[poses]
5	8	1×1000+8 hundred 1×60+34	1×1000+9 hundred 2	12 *gur* 4 *bariga* 1 1/3 *sila*	6×60+24 *gur* 4 *ban*	
6	men,				all (of whom are) of	the palace

Rev

7	Month 9, festival of *Nergal*
8	Year after, with the strong weapon of An, Enlil, (and) Enki
9	Isin, the royal capital
10	and the various villages
11	*Rīm-Sîn* the true shepherd
12	seized (*Rīm-Sîn* year 31)

YBC 04721
CDLI number: P305873
Copy: Grice 1919: no. 103
Edition: Robson 2004a: 128, 129
Collation: 12 November 2013

Date formula: *Rīm-Sîn* of Larsa year 01, month 01, day 07.

YBC 04721, attributed here to *Šamaš-aššu-aplu* (Appendix 2.I), can be described as a balanced account arranged in tabular array along multiple axes. It describes grain allocations to three cities, Larsa, Ur and a city of which the name is broken, as well as individuals receiving the grain. Provenance is uncertain, although perhaps a location near Larsa can be suggested. This is because three cities are mentioned that receive grain, as well as four individuals, which implies a high level of management and centrality. A central location would fit well in the capital of the kingdom of Larsa with its proximity to the royal court. Perhaps it was produced by the head of the bureau of irrigation and excavation as suggested in Sect. 4.2.

Transliteration

Obv	1	2	3	4	5	6
1 2	še sag-nig$_2$-gur$_{11}$	*a*-⸢*na*⸣ uri$_2^{ki}$	*a*-⸢*na*⸣ ⸢x⸣[…]	*a-na* ⸢larsa^{ki}⸣-ma	šu-nigin	mu-bi-im
3	5(geš$_2$) 1(aš)	5(geš$_2$) 1(aš)			5(geš$_2$) 1(aš)	*li-pi$_2$-it*-^{d}Sîn
4 5	5(geš$_2$) 1(aš)		3(geš$_2$) ⸢3(u)⸣ 4(aš) ⸢3(bariga) 4(ban$_2$)⸣	1(geš$_2$) 2(u) 6(aš) 1(bariga) 1(ban$_2$) ⸢5(diš)⸣	5(geš$_2$) 1(aš)	*nu-ur$_2$*-^{d}*a$_2$-ḫe$_2$*
			5(diš)			
6	4(geš$_2$) 5(u) 6(aš) / 2(bariga)	3(geš$_2$) gur	[1(geš$_2$) gur]	5(u) 6(aš) 2(bariga)	4(geš$_2$) ⸢5(u) 6(aš)⸣ / 2(bariga)	*i$_3$-li$_2$*-uru-zu
7 8 9	4(geš$_2$) 3(u) 7(aš) 3(bariga) 2(ban$_2$) *iš*-	 *tu* 2(u) ⸢3(aš)	 1(bariga) 4(ban$_2$)⸣	4(geš$_2$) 3(u) 7(aš) 3(bariga) 2(ban$_2$) erin$_2$ ⸢^{d}Šamaš-*aš-šu-ap-lu*⸣	4(geš$_2$) ⸢3(u)⸣ 7(aš) ⸢3(bariga) 2(ban$_2$)⸣ ⸢Šamaš x x⸣	^{d}Šamaš-*ki-ma*-engar
Rev						
10 11 12 13 14	1(geš'u) 9(geš$_2$) 3(u) 6(aš) 2(ban$_2$) ⸢gur⸣ *iš-tu* *u$_3$*$^!$ 2(u) 3(aš)	8(geš$_2$) 1(aš) še-gur lu$_2$ 1(bariga 4(ban$_2$)	⸢4(geš$_2$)⸣ 3(u) 4(aš) 3(bariga) 4(ban$_2$) 5(diš) gu$_2$-un gur erin$_2$^{d}	7(geš$_2$)$^!$ gur 1(bariga) 3(ban$_2$) 5(diš)⸢sila$_3$⸣ Šamaš-⸢*aš-šu-ap-lu*⸣	1(geš'u) 9(geš$_2$) 3(u) 6(aš) 2(ban$_2$) gur	
15 16				iti bara$_2$-za$_3$-gar u$_4$ 7(diš)- mu ^{d}*ri-im*-^{d}Sîn lugal	kam	

Translation

Obv	1	2	3	4	5	6
1	Grain Capital	To	To	To	Total	Its name
2		Ur	⌜x⌝[...]	Larsa		
3	5×60+1 *gur*	5×60+1 *gur*			5×60+1 *gur*	*Lipit-Sîn*
4	5×60+1 *gur*		3×60+34 *gur*	1×60+26 *gur*	5×60+1 *gur*	*Nūr-Aḫe*
5			3 *bariga* 4 *ban* 5	1 *bariga* 1 *ban* 5		
6	4×60+56 *gur* / 2 *bariga*	3×60 *gur*	[1×60 *gur*]	56 *gur* 2 *bariga*	4×60+56 *gur* / 2 *bariga*	*Ilī-uruzu*
7	4×60+37 *gur*			4×60+37 *gur*	4×60+37 *gur*	*Šamaš-kima-ikkaru*
8	3 *bariga* 2 *ban*			3 *bariga* 2 *ban*	3 *bariga* 2 *ban*	
9	from	2⌜3 *gur*	1 *bariga* 4 *ban*⌝	men of	*Šamaš-aššu-aplu*	
Rev						
10	19×60+36	8×60+1 *gur*	⌜4×60+34 *gur*	7×60! *gur*	19×60+36	
11			3 *bariga* 4 *ban* 5	1 *bariga* 3 *ban* 5 *sila*		
12	*gur* 2 *ban*				*gur* 2 *ban*	
13	from	gur grain, taxed? persons				
14	and 23 *gur*	1 *bariga* 4 *ban*	men of	*Šamaš-aššu-aplu*		
15				month 1 day 7		
16				year *Rīm-Sîn* is king / (*Rīm-Sîn* year 1)		

Notes

10 Column 4 shows a mistake. The expected value is 7(geš$_2$) gur, not 8(geš$_2$).

YBC 12273
CDLI number: P312229
Copy: Middeke-Conlin forthcoming b
Edition: Middeke-Conlin forthcoming b

Date Formula: *Hammu-rābi* of Babylon year 38 (1755 BCE), month 3, day 25.

YBC 12273, associated with scribe Q of the bureau of irrigation and excavation (Appendix 2.II), estimates labor expenditures in an excavation. The first four columns of YBC 12273 describe an excavation: column 1 states length, column 2 states depth instead of width which is found and repeated in column 3. Column 4 then states volume. After volume labor is described with a work assignment in column 5 and then the man-day's labor expended during the excavation work in column 6. Finally, column 7 states what stretch is excavated. In line 10, the person charged with this excavation is named, *Namīram-šarur*. Unfortunately, much of the text is broken so that a complete synopsis is not possible.

Transliteration

Obv	1	2	3	4	5	6	7
1	uš	bur$_3$-u	dagal dagal	saḫar-bi	eš$_2$-gar$_3$	erin$_2$-bi	mu-bi-im
2	4(u) 5(diš)	3(u)	2(u)	1(u) 5(diš) / sar	1(u) gin$_2$$^?$	1(geš$_2$) 3(u)	ki 1(diš)
3	1(u)	3(u)	2(u)	3(diš) ⸢1/3 / sar⸣	1/3$^!$ sar	1(u)	ki 2(diš)
4	i$_3$$^?$ dab$_5$$^?$				[…]	⸢x-x-ša-	aš⸣
5	1(diš) 3(u)	1(dis)	1(u) 5(diš)	2(u) 2(diš) / ⸢1/2⸣ [sar			]
6	2(diš)	1(diš)	1(u) 5(diš)	[…			]
7	⸢x a$^?$ ša	x	ul-ta⸣	[…			]
Rev	[…]						
8	4(diš) 2(u)5(diš)			[…			]
9	1/2 ninda 2 kuš$_3$ dagal$^?$ eš$_2$-gar$_3$ […]						
10	[…] ⸢ x ir-ri x x⸣						
11	⸢i$_3$$^?$ dab$_5$$^?$ *ša na-mi-ra-am-ša*⸣*-ru-*[*ur*] *u$_2$-še-eh-ru*						
12	iti sig$_4$-a u$_4$ 25-kam$_2$						
13	mu eš$_3$-nun-na^{ki} a gal-gal-la						
14	mu-un-gul-e						

Translation

Obv	1	2	3	4	5	6	7
1	length	depth	width, width	its volume	work assignment	its men	its name
2	45	30	20	15 *sar*	10 *gin*$^?$	1×60+30	place 1
3	10	30	20	3 1/3 *sar*	1/3 *sar*	10	place 2
4	charge of				[…]	…	…
5	1:30	1	15	22 1/2[*sar*			]
6	2	1	15	[…			
7	…	…	…	[…			]
Rev	[…]						
8	4:25			[…			]
9	1/2 *ninda* 2 *kuš* width, work assignment […]						
10	[…]…irra						
11	charge$^?$ which *Namīram-šar*[*ur*] had excavated						
12	Month 3, day 25						
13	Year Ešnunna was destroyed						
14	by flood (*Hammu-rābi* year 38)						

Note

3 Column 5 There is an additional wedge in 1/3 *sar*, rendering it possible that this is 22 *sar*, not 1/3 *sar*. However, the wedges' arrangement does not match 2(u) 2 (dis), nor would calculation work with 22 *sar*.

1.B Mathematical Texts

IM 57828
Excavation number: 2 N-T 030
CDLI number: P254904
Photo: Steele 1951: 25
Edition: Neugebauer and Sachs 984: 247, 248; Proust 2007: 194.

Transliteration

1(diš) 4(u) 5(diš)	
1(diš) 4(u) 5(diš)	
<3(diš) 3(diš) 4(u) 5(diš) >	
	1/3 kuš$_3$ 1/2 šu-si-ta-am$_3$ ib$_2$-si$_8$
	a-ša$_3$-bi en-nam
	a-ša$_3$-bi*
	9(diš) še igi 5(diš) 3(diš) še-kam

Translation

1:45	
1:45	
<3:3:45>	
	1/3 *kuš* 1/2 *šusi* per (side) equal sides
	what (is) its area
	Its area (is)
	9 še one-5th (of) a 3rd is of *še*

Notes

*Restoration follows Proust (2007) and is based on the photo published by Steele (1951).

M 10
CDLI number: Undefined
Copy: Sachs 1952: 152
Edition: Sachs 1952: 151–153

	Transliteration Obverse	**Translation** Obverse
1	igi-7(diš)-bi 8(diš) 3(u) 4(diš) 1(u) 6(diš) 5(u) / 9(diš) *si-i$_3$-tum*	The reciprocal of 7 is 8:34:16:59 deficit.
2	i<gi>-7(diš)-bi 8(diš) 3(u) 4(diš) 1(u) 8(diš) diri	The reciprocal of 7 is 8:34:18. Excess.
3	igi-1(u)1(diš) 5(diš) 2(u) 7(diš) 1(u) 6(diš) 2(u) / 2(diš) *si-i$_3$-tum*	The reciprocal of 11 is 5:27:16:22 deficit ^{sic}
4	igi-1(u) 3(diš) 4(diš) 3(u) 6(diš) 5(u) 5(diš) / *si-i$_3$-tum*	The reciprocal of 13 is 4:36:55 deficit
5	igi-1(u) 4(diš) 4(u) 2(diš) 5(u) 1(diš) 2(u) 5(diš) / 4(u) *si-i$_3$-tum*	The reciprocal of 14 is 42:51:25:40^{sic} deficit^{sic}
6	igi-1(u) 7(diš) 3(u) 5(diš) [1(u)] 7(diš) *si-i$_3$-tum*	The reciprocal of 17 is 35:17^{sic} deficit^{sic}

Interpretation[7]

I. Number	II. Approximate Reciprocal	III. Stated Excess/Deficit	IV. Number multiplied by Approximate Reciprocal	V. Corrected Approximate Reciprocal
7	8:34:16:59	Deficit	59:59:58:53	8:34:1**7**:…
7	8:34:18	Excess	1:0:0:6	8:34:1**7**:…
11	5:27:16:22	Deficit^{sic}	1:0:0:0:2	5:27:1**6:21:49**:…
13	4:36:55	Deficit	59:59:55	4:36:55:**23**:…
14	42:51:25:40^{sic}	Deficit^{sic}	9:59:59:59:20	**4:17:8:34**:…
17	35:17^{sic}	Deficit^{sic}	9:59:49	**3:31:45:52:56:28:14:7**:…

N 3914
CDLI number: P278884
Copy: Robson 2000: 27, 28 no. 10
Edition: Robson 2000: 27, 28; Friberg 2007: 165

[7]After Sachs (1952: 152).

Translation

		3:25:40		
1	7	1:10	1:10	11:40
2	3:30	35	1:10	
3	2:20	[23]:20	1:10	
4	1:45	17:30	1:10	
5	1:24	14:40	1:10	
[6]	1:10	11:40		
[7]	1	10		
[8]	52:30	8:45		
[9	4]6:40	7:[46:40]		
[10	42	7]		

NI 18
CDLI number: P368708
Copy: Proust 2007: p. 1
Edition: Proust 2007: 193

Transliteration

2(diš) 1(u)	
2(diš) 1(u)	
4(diš) 2(u) 6(diš) sic 4(u)	
	1/3 kuš$_3$ 3(diš) šu-si ib$_2$-si$_8$
	a-ša$_3$-bi [en-nam]
	a-ša$_3$-bi 1(u) 3(diš) še
	igi 4(diš)-gal$_2$ še

Translation

2:10	
2:10	
4:26^{sic}:40	
	1/3 *kuš* 3 *šusi* equal sides
	[what (is)] its area
	Its area (is) 13 *še*
	one-4th *še*

MS 2830
CDLI Number: P251877
Copy: Friberg 2007: 159
Friberg 2007: 157–160, copy p. 159

§2a translation

1 *gin* silver			
1	1	28:48	28:48
2	30	14:24	28:48
3	20	9:36	28:48
4	15	7:12	28:48

§2b translation

1 *gin* silver			
2	30	28:7:30	56:15
3	20	18:45	56:15
15	4	3:45	56:15
6	10	9:22:30	56:15

PTS 247
CDLI number: P254793
Copy: Neugebauer and Sachs 1945: 18

Edition: Neugebauer and Sachs 1945: 18, Friberg et al. 1990: 534.

Friberg (2001: 75), referring to Neugebauer and Sach's type 1 brick, states that 'the "help table" PTS 247 (…) was probably used in order to compute the number of bricks of type R1v in a step pyramid of a certain kind. In the table, L brick sar with L = 6, is expressed as '1.12' (sixties) = 4320'. This, however, is not substantiated beyond the relationship of 10, which is broken, to the number 6, which would hypothetically respond to the built wall coefficient for type 1 bricks (cf. Robson 1999: 67–69) in the first row of the table. One could equally suggest it is an excavation of several ditches at different rates because 10 is the coefficient for volume in *gin* of one man's work assignment (Robson 1999: 96, 97) and 3:45 is an earth wall coefficient (Robson 1999: 93, 94). This is made plausible by the appearance of the centesimal system in the bureau of irrigation and excavation. However, the appearance of the centesimal system on the upper edge, rather than system S or brick *sar*, as well as the play on 10 in the first line of the obverse may suggest this is a simple exercise in examining the translation between base 100 and 60. All suggestions are hypothetical.

Translation

4 thousand 3 hundred and 20			
	3:45		
[10]	1:40	2	1:12
7:30	56:15	1:7:30	1:12
5	25	30	1:12
2:30	6:15	7:30	1:12

UET 6/2 233
Excavation number: U 17207.034
CDLI number: P254860
Copy: Robson 1999: 253
Edition: Robson 1999: 253; Friberg 2000: 125

Translation

Rev

5	10
2	30
3	3
10 6	
2	6

UET 6/2 295
CDLI number: P254878
Copy: Robson 1999: 250
Edition: Robson 1999: 250; Friberg 2000: 103ff

Translation

Rev

2:5	12
25	2:24
28:48	1:15
36	1:40
2:5	

Interpretation

Number	Factor	Reciprocal of factor	Calculation
2:5	5	12	2:5 × 12 = 25
25	25	2:24	2:24 × 12 = 28:48
28:48	48	1:15	28:48 × 1:15 = 36
36	36	1:40	1:40 × 1:15 = 2:5

This text aims to extract the reciprocal of 2:5, so 2:5 is placed on the upper left of the text. A factor of 2:5 is found, 5, which is also the trailing part of this number (hence the algorithm's modern name, the trailing parts algorithm). The reciprocal of the factor 5 is found using the standard list of reciprocals and then multiplied by the original number 2:5 to produce another factor, 25. 25 is then placed below 2:5 on UET 6/2 295 and its reciprocal found, 2:24. Once all factors are found, the reciprocals of each factor are multiplied together to find the reciprocal of 2:5, which is, 28:48. The author of this text repeated this process to find the reciprocal of 28:48, that is, the original number 2:5. Note that the reciprocal of 28:48 is 2:5 is important to the solution of MS 2830 §2a discussed in Chap. 8.

VAT 08521
CDLI number: P254949
Copy: Neugebauer 1935–1937: II pl. 54
Photo: Neugebauer 1935–1937: II pl. 29
Edition: Neugebauer 1935–1937: I, 351–356; Neugebauer 1935–1937: III 59; Thureau-Dangin 1938: 121–123
Discussions: Muroi 1990

VAT 08521 is tentatively placed by Goetze (1945: 149, 150) into group IV which he in turn tentatively places in Uruk . This is followed by Høyrup (2002: 333–337). Language is Akkadian with Sumerograms, or Sumerian words used to represent Akkadian words, mixed in.

	Problem 1 transliteration	**Problem 1 translation**
	Obv	Obv
1	a-na [1(diš) ma-na ku$_3$]⸢-babbar⸣ 1(u) 2(diš) gin$_2$ / *i-di-*⸢*in*⸣*-ma*	One gives for [1 *mana* si]lver 12 *gin*
2	maš$_2$ ib$_2$-si$_8$ *li-id-di-kum*	so that the interest given you has a square root.
3	1(diš) ma-na gar-ra 1(u) 2(diš) maš$_2$ gar-ra	Set 1 *mana*, set 12 interest.
4	1(diš) 4(u) a-ra$_2$ *ša* ib$_2$-si$_8$ *i-na-di-nu-kum* gar-ra	Set 1:40 multiplication of the square root / given to you.
5	1(u) 2(diš) ⸢maš$_2$⸣ *a-na* 1 ma-na il$_2$ 1(u) 2(diš)	Raise 12 interest to 1 *mana*: 12.
6	igi 1(u) 2(diš) *pu-ṭur-ma* [5(diš)] *a-na* 1(diš) 4(u) / a-ra$_2$ [*ša ša-ak-nu*]	detach the reciprocal of 12 and [5] to 1:40, the / multiplication [which is set]
7	il$_2$ ⸢8(diš)⸣ 2(u) ⸢sag ku$_3$⸣-babbar	raise. 8:20 (is) the principal silver.
8	*šum-ma* 8(diš) 2(u) ⸢sag ku$_3$⸣-babbar *a-na* 1(diš) / ma-na 1(u) 2(diš) gin$_2$ *lu-ud-di-im-ma*	If I should give 8:20 silver principal at 1 *mana* / (is) 12 gin
9	1(diš) 4(u) maš$_2$-bi [1(diš)] *li-id-di-nam*	so that 1 gives me 1:40 its interest
10	1(diš) ma-na *a-na* 1(u) 2(diš) ⸢maš$_2$-bi⸣ il$_2$ 1(u) 2(diš)	raise 1 *mana* to 12 its interest: 12
11	1(u) 2(diš) *a-na* 8(diš) 2(u) sag ⸢ku$_3$-⸣[babbar] ⸢il$_2$⸣ / 1(diš) 4(u) maš-bi	raise 12 to 8:20 si[lver] principal: 1:40 its / interest.
12	i b$_2$-si$_8$ 1(diš) 4(u) en-nam 1(u)	What is the square root of 1:40? 10.

YBC 04607
CDLI number: P235642
Copy: Neugebauer and Sachs 1945: pl. 12
Photo: Proust forthcoming
Edition: Neugebauer and Sachs 1945: 91–97; Proust forthcoming

The full text of YBC 04607 has 10 problems between the obverse and reverse. Here only the first five statements, which appear on the obverse and first three lines of the reverse, are presented. For the most recent collation and edition of the full text, see Proust (forthcoming). Here Proust's collation and interpretation is followed.

	Problem 1 transliteration Obv	**Problem 1 translation** Obv
1	sig$_4$ 1/2 kuš$_3$ uš-bi	A brick: 1/2 *kuš* its length
	1/3 kuš$_3$ sag-bi 5(diš) šu-si sukud-bi	1/3 *kuš* its width, 5 *šusi* its height.
	gagar saḫar-bi *u*$_3$ i$_3$-šam$_2$* saḫar-bi en-nam	Its base, its volume and its equivalent capacity / (are) how much?
	1(u) 2(diš) še šu-ri-a še gagar-bi 2 še *u*$_3$ <igi> / 1(u) 2(diš)-gal$_2$ še saḫar-bi	12 *še* and one-half its base, 2 *še* and one-12th *še* / its volume,
5	3(diš) 1/3 sila$_3$ 8(diš) 1/3 gin$_2$ i$_3$-šam$_2$ saḫar-bi	3 1/3 *sila* 8 1/3 *gin* its equivalent capacity.
	Problem 2 transliteration	**Problem 2 translation**
6	sig$_4$ 18 šu-si uš-bi	A brick. 18 *šusi* its length,
	1(u) 2(diš) šu-si sag-bi 5(diš) šu-si sukud-bi	12 *šusi* its width, 5 *šusi* its height.
	gagar saḫar-bi *u*$_3$ i$_3$-šam$_2$ saḫar-bi en-nam	Its base, its volume and its equivalent capacity / (are) how much?
	1(u) 8(diš) še gagar 3(diš) še saḫar-bi [5(diš)]⸢ sila$_3$ / i$_3$-šam$_2$⸣ saḫar-bi	18 *še* its base, 3 *še* its volume, [5] *sila* its / equivalent capacity
	Problem 3 transliteration	**Problem 3 translation**
10	sig$_4$-ab$_2$ 2/3 kuš$_3$ uš-bi	A half-brick. 2/3 *kuš* its length,
	1/3 kuš$_3$ sag-bi 5(diš) šu-si sukud-bi	1/3 *kuš* its width, 5 *šusi* its height.
	gagar saḫar-bi u$_3$ i$_3$-šam$_2$ saḫar-bi en-nam	Its base, its volume and its equivalent capacity / how much?
	1(u) 6(diš) še šu-ri-a še *u*$_3$ igi 6(diš)-gal$_2$ ⸢ še še-bi⸣	16 *še* one-half *še* and ⅙ *še* its base$^!$,
	2(diš) še šu-ri-a še igi 4(diš)-gal$_2$ [še xxx]-x-gal$_2$ / saḫar	2 *še* one-half *še* one-4th [*še* and xxx]-x its / volume,
15	4(diš) 1/2 sila$_3$ 7(diš)$^!$(6(diš)^{sic}) 2/3 <gin$_2$> 2(u) še / i$_3$-[šam$_2$ saḫar-bi]	4 1/2 *sila* 7$^!$ 2/3 <*gin*> 20 *še* its equivalent / [capacity].
	Problem 4 transliteration	**Problem 4 translation**
	sig$_4$-al-ur$_3$-[ra]	A square brick.
	2/3 kuš$_3$-ta-am$_3$ ib$_2$-sa$_2$ 5(diš) šu-si [sukud-bi]	2/3 *kuš* each equal side, 5 *šusi* [its height].
	gagar saḫar-bi *u*$_3$ i$_3$-šam$_2$ saḫar-bi en-nam	Its base, its volume and its equivalent capacity / how much?
	igi 6(diš)-gal$_2$ <gin$_2$> 3(diš) še u$_3$ igi 3(diš)-gal$_2$ še / gagar	One-6th <*gin*> 3 *še* and one-3rd *še* (its) base.
20	5(diš) še šu-ri-a še u$_3$ igi 9(diš)-gal$_2$ šu-ri-a še saḫar	5 *še* one-half *še* and one-9th (of) one-half *še* / volume
	Problem 5 transliteration	**Problem 5 translation**
	sig$_4$-al-ur$_3$-ra 1 kuš$_3$-ta-am$_3$ ib$_2$-sa$_2$	A square brick. 1 *kuš* each equal side,
	5(diš) šu-si sukud-bi gagar saḫar-bi u$_3$ i$_3$-šam$_2$ / saḫar-bi en-nam	5 *šusi* its height. Its base, its volumes and its / equivalent capacity how much?
	1/3 gin$_2$ u$_3$ 1(u) 5(diš) še gagar 1(u) ⸢2(diš)⸣ še / šu-ri-a še saḫar-bi	1/3 *gin* and 15 *še* (its) base, 12 *še* one-half *še* its / volume.

Notes

13 Proust notes that while this line reads ‘še še-bi ’following her own collation and Neugebauer and Sachs’ reading, ‘še gagar-bi’ is expected.

14 Proust suggests reading this line as šu-ri-a še u$_3$ igi 6$^!$-gal$_2$ noting that an expected 1/4 + 1/36 še volume, restored as ‘igi-4-gá[l še ù igi-9 igi-]4-gál saḫar’ by Neugebauer and Sachs, is uncertain. There is a large break, probably the result of a pickaxe, so that what remains is uncertain as well. Several characters follow the break that seem to be the remains of a fraction. While Neugebauer and Sachs suggest 4(diš), the break allows for a 6(diš) or more so that this is uncertain. However, restoring [igi 3(u)]6(diš)-gal$_2$ is unlikely. In addition, there is no written še after this last value as expected. Proust suggests the fraction could have been rounded off even if this is atypical in mathematical texts of the period. However, see YBC 04669 problem 9 for a rounded value in a mathematical text.

YBC 04663

CDLI number: P254984

Copy: Neugebauer and Sachs 1945: pl. 7

Edition: Neugebauer and Sachs 1945: 69–71, Proust forthcoming Problems 1, 2

Problem 1 transliteration

Obv

1	ki-la$_2$ 5(diš) ninda uš 1(diš) 1/2 ninda <sag> 1/2 ninda bur$_3$-bi 1(u) <gin$_2$> saḫar eš$_2$-gar$_3$ 6(diš) ⸢še⸣ [a$_2$-bi]
2	gagar saḫar-ḫi-a erin$_2$-ḫi-a *u$_3$* ku$_3$-babbar en-nam za-e in-da-zu-de$_3$
3	uš sag gu$_7$-gu$_7$-ta 7(diš) 3(u) *i-na-ad-di-ik-ku*
4	7(diš) 3(u) *a-na* bur$_3$-bi *i-ši* 4(u) 5(diš) *i-na-ad-di-ku*
5	igi eš$_2$-gar$_3$ du$_8$ 6(diš) *i-na-ad-di-ku a-na* 4(u) 5(diš) ⸢*i*⸣*-ši* 4(diš) 3(u) *i-na-di-ku*
6	4(diš) 3(u) *a-na i-di i-ši* 9(diš) *i-na-di-ku ki-a-am* ⸢*ne$_2$-pe-šu*⸣

Problem 7 transliteration

40	9(diš) gin$_2$ ku$_3$-babbar ki-la$_2$

Rev

41	ku$_3$ ki-la$_2$ uš *u$_3$* sag gar-gar-ma 6(diš) 3(u) 1/2 ninda [bur$_3$-bi]
42	1(u) gin$_2$ eš$_2$-gar$_3$ 6(diš) še a$_2$-bi uš sag-bi en-nam
43	za-e in-da-zu-de$_3$ igi a$_2$-bi *pu-ṭu-ur*
44	*a-na* 9(diš) gin$_2$ ku$_3$-babbar *i-ši* 4(diš) 3(u) *i-na-di-ku-um*
45	4(diš) 3(u) *a-na* eš$_2$-gar$_3$ *i-ši* 4(u) 5(diš) *i-na-di-ik-ku*
46	igi bur$_3$-bi du$_8$ *a-na* 4(u) 5(diš) *i-ši* 7(diš) 3(u) *i-na-di-ku*
47	1/2 uš *u$_3$* sag *ša* gar-gar-*ru ḫe$_2$-pe* 3(diš) 1(u) 5(diš) *i-na-di-ku*
48	3(diš) 1(u) 5(diš) gu$_7$-gu$_7$-ta 1(u) 3(u) 3(diš) 4(u) 5(diš) *i-na-di-ku*
49	7(diš) 3(u) *i-na li-bi* 1(u) 3(u) 3(diš) 4(u) 5(diš) *u$_2$-su$_2$-uh*
50	3(diš) 3(diš) 4(u) 5(diš) *i-na-ad-di-ik-ku* ib$_2$-si$_8$-*šu le-qe$_2$*
51	1(diš) 4(u) 5(diš) *i-na-di-ku a-na* 1(diš) *ṣi$_2$-ib a-na* 1(diš) *ḫu-ru-uṣ$_4$*
52	uš sag *i-na-di-ku* 5(diš) <ninda> uš 1(diš) 1/2 ninda sag

Problem 1 translation

Obv

1	A trench: 5 *ninda* (is) the length, 1 1/2 *ninda* <the width>, (and) 1/2 *ninda* the depth. 10 <*gin*> volume / (is) the work assignment, 6 *š*[*e* (is) its (silver) wages.]
2	What are the area, the volume, the workers, and the silver (total)? You to know it:
3	Make the length encounter the width, it will give you 7:30.
4	Raise 7:30 to the height, it will give you 45.
5	Detach the reciprocal of the work assignment, it will give you 6. Raise to 45, it will give you 4:30.
6	Raise 4:30 to the wages, it will give you 9. The procedure.

Problem 7 translation

40	9 *gin* silver trench, the silver trench.

Rev

41	The silver of the trench. The length and the width I add and 6:30. 1/2 *ninda* [(is)its depth].
42	10 *gin* (is) the work assignment, 6 *še* (is) its wages. What are its length and width?
43	You to know it: Detach the reciprocal of its wages
44	(and) raise to 9 *gin* silver, it will give to you 4:30.
45	Raise 4:30 to the work assignment, it will give you 45.
46	Detach the reciprocal of its depth (and) raise to 45, it will give you 7:30.
47	Break 1/2 of the length and the width which are added, it will give you 3:15.
48	Make 3:15 encounter (itself), it will give you 10:33:45.
49	Tear out 7:30 from the middle of 10:33:45,
50	it will give you 3:3:45. Take its square root,
51	it will give you 1:45. To the 1 add, to 1 subtract,
52	it will give you the length (and) width: 5 <*ninda*> length, 1 1/2 *ninda* width.

YBC 04666
CDLI number: P254985
Copy: Neugebauer and Sachs 1945: pl. 9
Edition: Neugebauer and Sachs 1945: 76–80

This text is not provided a group by Goetze (1945), although Høyrup (2002: 349) places it in Goetze's group 2 of unknown provenance along with YBC 04663.

Problem 1 transliteration
Obv

1	[pa$_5$]-⸢sig 5(diš) GAR⸣ UŠ uš-bi 2(diš) kuš$_3$ dagal 1(diš) kuš$_3$ bur$_3$-bi
2	[1/3 gin$_2$ saḫar] eš$_2$-gar$_3$ 1(ban$_2$) še a$_2$-bi lu$_2$ huĝ-ga$_2$
3	⸢gagar saḫar-ḫi-a⸣ erin$_2$-ḫi-a *u*$_3$ še en-nam 1(ubu) GAN$_2$ gagar 1(ubu) GAN$_2$ saḫar-ḫi-a
4	2(geš$_2$) 3(u) erin$_2$-ḫi-a 5(aš) gur še-e

Problem 1 translation
Obv

1	A subsidiary [canal]: 5 *uš* its length, 2 *kuš* width, 1 *kuš* its depth.
2	[1/3 *gin* volume] work assignment, 1 *ban* grain its wage, hired hand.
3	What are the area, the volume, the (number of) workers, and the grain (total)? 1 *ubu* area, 1 *ubu* volume,
4	2×60+30 men, 5 *gur* grain.

YBC 04669
CDLI number: P254987
Copy: Neugebauer 1935–1937: III T. 3
Edition: Neugebauer 1935–1937: I 514–516 statements 1–9, B1, B11; III 26–29 statements 10–14, B1-11; Thureau-Dangin 1938: 208–210 statements 1–4, 7, 10–11; Neugebauer and Sachs 1945: 103 statement 4; Proust forthcoming statements 1–9

	Problem 9 transliteration	**Problem 9 translation**
	Obv	Obv
9	$^{\text{giš}}$nig$_2$ 1(diš) ⸢gin$_2$⸣	A bushel of 1 *gin*:
10	1(diš) šu-si [dal]	1 *šu-si* [transversal.]
11	sukud-bi en-nam	How much is its height?
12	3(diš) 1/2 šu-si sukud	3 1/2 *šu-si* is the height.

YBC 04698
CDLI number: P255010
Copy: Neugebauer 1935–1937: III pl. 5
Edition: Neugebauer 1935–1937: I 513; Friberg 2005: 60, 61; Middeke-Conlin and Proust 2014

For the entire text see Middeke-Conlin and Proust (2014), which this transliteration and translation follows and where provenance is suggested as central Mesopotamia, perhaps around Sippar or Kiš (*ibid.*: 1.4). For statement 3 in particular, see also Friberg (2005: 50–61).

	Statement 1 transliteration	**Statement 1 translation**
	Obv	Obv
1	1 še a-na 1(aš) še gur	(When the principal in) grain (is) as much as 1 *gur* of / grain
2	1(bariga) še a-na maš$_2$ šum$_2$	1 *bariga* of grain as the interest I give.
3	še *u*$_3$ maš$_2$ en-nam	The grain and the interest are how much?
	Statement 2 transliteration	**Statement 2 translation**
4	še a-na 1(aš) še gur	(When the principal in) grain (is) as much as 1 *gur* of / grain,
5	1(bariga) 4(ban$_2$) a-na maš$_2$ šum$_2$	1 *bariga* 4 *ban* as the interest I give.
6	še *u*$_3$ maš$_2$ en-nam	The grain and the interest are how much?
	Statement 3 transliteration	**Statement 3 translation**
7	3(diš) sila$_3$-ta i$_3$-sag	(Rates in-kind are) 3 *sila* of premium oil per (*gin*)
8	1(ban$_2$) 2(diš) sila$_3$-ta i$_3$-geš	(and) 1 *ban* 2 *sila* of common oil per (*gin*)
9	1(diš) gin$_2$ ku$_3$-babbar šum$_2$	1 *gin* silver I gave.
10	i$_3$-geš *u*$_3$ i$_3$-sag	Common oil and first quality oil
11	ib$_2$-sa$_2$-*ma* sa$_{10}$	I made equal and I bought.
	Statement 14 transliteration	**Statement 14 translation**
	Rev	Rev
17	ganba a-na 1(diš) 2(diš) 3(diš) 4(diš) 5(diš)	(When) (in-kind) going rates (are) as much as 1 2 3 4
18	6(diš) 7(diš) 8(diš) 9(diš) ganba	5 6 7 8 9, the going rate (in grain).
19	1(bariga) še šum$_2$ še he$_2$-e$_3$	1 *bariga* I give. Let the grain rise
20	*u*$_3$ he$_2$-e$_{11}$-*ma*	or fall so that
21	ganba ib$_2$-sa$_2$	the (in-kind) going rates are equal.

Notes

18 Friberg (2005: 60, 61) reads šu-si rather than ganba here and in Middeke-Conlin and Proust (2014).

19 Friberg (2005: 60, 61) reads ‘1 še si$_3$ še šam$_2$-ma’ while Neugebauer (1935–1937: I 513) reads ‘1 gun$_2$ sum še ib$_2$-sa$_2$ du$_6$’. 1(bariga) is probable but not certain. Neugebauer (1935–1937: I 513) read this ‘3(gur)(?)’ while Friberg (2005: 60, 61) reads ‘1(gur) še’. See Middeke-Conlin and Proust (2014: Sect. 5.14) for this.

YBC 07164
CDLI number: P255042
Copy: Neugebauer and Sachs 1945: pl. 10
Edition: Neugebauer and Sachs 1945: 81–88; Robson 1999: 99–102 problem 2; Friberg 2000: 126 problem 2

Problem 7 transliteration

Obv

15	pa$_5$-sig 5(diš) UŠ uš 3(diš) kuš$_3$ dagal 3(diš) kuš$_3$ bur$_3$-bi 1 kuš$_3$ *šu* 1/3 ma-na *ši-lu-tum*
16	2(diš) kuš$_3$ *šu* 1(u) gin$_2$ dusu lu$_2$ 1-e igi-te-en u$_4$ *ši-lu-ta-am ih-re*
17	igi-te-en u$_4$ dušu *ih-re u$_3$* [saḫar] en-nam igi-5(diš)-gal$_2$ u$_4$ *ši-lu-ta-am*
18	4(diš) gin$_2$ saḫar *is-su$_2$-uh* 2/3 [u$_4$] u$_3$ igi 5(diš)-gal$_2$ 2/3 u$_4$ dusu *ih-re* 8 gin$_2$ saḫar

Problem 8 transliteration

19	pa$_5$-sig ⸢libir⸣-ra 5(diš) UŠ uš 1(diš) kuš$_3$ dagal 1(diš) kuš$_3$ bur$_3$-bi
20	*te-er-di-is-sa$_3$* 1/2 kuš$_3$ *ta-ra-hi-ša u$_3$-ša-mi-iṭ* saḫar-bi en-nam 1/3 sar 5(diš) gin$_2$$^{\text{sic}}$

Problem 7 translation

Obv

15	A subsidiary canal: 5 *uš* (is) the length, 3 *kuš* (is) the width, 3 *kuš* (is) its depth, (the first) 1 *kuš* depth / (is) 1/3 *mina* throw-out work.
16	2 *kuš* depth (is) 10 *gin* 'basket' work. What fraction of the day did 1 man dig the throw-out work?
17	what part of the day did he dig the 'basket' work? and what is the [volume]? One-5$^{\text{th}}$ day the throw-out / work
18	he excavated 4 *gin* volume. For 2/3 [day] and one-fifth of 2/3 day he dug the 'basket' work, 8 *gin* (is) / the volume.

Problem 8 translation

19	An old subsidiary canal: 5 *uš* (is) the length, 1 *kuš* (is) the width, 1 *kuš* (is) its depth, (the first) 1 *kuš* / depth (is) 1/3 *mina* throw-out work.
20	its expanded (volume) shaving off 1/2 *kuš* of its lining. What is its volume? 1/3 *sar* 5 *gin*.

Notes

15, 16 Neugebauer and Sachs (1945: 81), state that *šu* is an abbreviation for *šuplum* which is reflected in Robson's reconstruction of *šu-*<*up-lum*> in her edition of problem 2.

15 Neugebauer and Sachs (1945: 88) connect the word *šīlūtum* with the verb *šalûm*, which can be translated 'to fling, cast away' (Black et al. 2000: 352) so that individuals digging at this level probably cast soil directly onto the ground level. Robson (1999: 100) translates this word "throw-out' work' which is followed here.

Neugebauer and Sachs (1945: 82) point out that *mana* is used where *sar* is intended.

16 As Neugebauer and Sachs (1945: 88) state, dušu is a kind of basket so that this probably means the individuals who are excavating cast dirt into a basket, which was carried out of the excavation and emptied. This is followed by Robson (1999: 100) who translates this as "basket' work'. Robson's translation is followed here.

20 Powell (1988: 170) following Neugebauer and Sachs (1945: 88) describes the *terdītum* as 'expansion, the additional volume of water gained by stripping off the sides and bottom of a canal to make it larger'. Powell (1988: 170) describes the *taraḫḫu* as 'the earth dug out from the sides or bottom of a canal or irrigation ditch to create extra water capacity'. See Neugebauer and Sach's (1945: 86) Figs. 22 and 23 for how they understand this excavation. Powell (1988: 170) describes the D-stem of *šamātum* as 'to expand a ditch/canal by shaving off the sides', improving on Neugebauer and Sach's (1945: 172) understanding of the root, *šmṭ* as, 'to cut, smooth'. Neugebauer and Sachs state that 5 gin$_2$ is a mistake for 25 gin$_2$, 2(u) is omitted in this statement.

Appendix 2
Numeracy by Scribe

In this appendix each scribe's activity and the practices exhibited by each scribe is presented in order to answer the question 'what do the texts tell us about each scribe'? It surveys practices that were explained throughout this volume, from lists and tables that made up the earliest elementary education described in Chap. 2 to more complex mathematical practices that were explored in Chaps. 5 through 8. Note that this appendix does not claim to be a complete survey of each scribal archive, but only a cursory survey to produce an initial image of each scribe's practice. Before moving on, however, it will help to outline the assumptions made and challenges overcome to produce this study.

It is assumed here that the person who commissioned or dictated a text—that is the scribe—is often synonymous with the text's author. This tends to be the case when no name is attributed with the scribe. In these examples it is suggested that the author of the text is the one carrying out calculation on behalf of a household, a bureau or a merchant. Accountability is assumed when no name is present. That is to say, when a text does not bear a personal name qualifying the text's perspective, it is assumed here that this qualification was implicit. This is the case with the scribes O and P of the grain production archive. Both authors are active during the reign of *Hammu-rābi*, although where is not completely certain. Only one text is attributed here to scribe O, Ashm 1923-311, but scribe P is suggested to author two texts studied here, Ashm 1922-277 and Ashm 1923-340. With *Itti-Sîn-milki*, whether he is the author of these texts or whether the author is a further scribe in his employ, it is suggested that a merchantoverseer like *Itti-Sîn-milki*, a man responsible for crown silver in both texts attributed to him here, would have carried out all calculations witnessed in the texts.

While most scribes in this study only have one text safely attributed to them here, some scribes have multiple texts attributed to them and these texts take some justification. Multiple methods are used to assign texts to a scribe. On the one hand, tablet shape can play an important part in attributing a text to a scribe. This is especially evident with NBC 11509, MAH 15886+16295, Riftin 1937: no. 114, Riftin 1937: no. 115, and Riftin 1937: no. 116, where all five texts take a similar

R. Middeke-Conlin, *The Making of a Scribe*, Why the Sciences
of the Ancient World Matter 4, https://doi.org/10.1007/978-3-030-35951-5

shape. Text layout can play an important role as well. With these texts, atabular format is used to express numeric data. In addition, subject matter can help elucidate who wrote a text. The same texts all center around work, NBC 11509 is a project statement that describes an excavation while MAH 15886+16295, Riftin 1937: no. 114, Riftin 1937: no. 115 and Riftin 1937: no. 116 state labor allocated to some form of excavation or other construction project and then estimate cost associated with these projects. Moreover, personal names can help to delimit the author of the texts. These texts all contain a personal name who acts as overseer, *Rīm-Sîn-rappašunu*. Date is also important. Four out of five of these same texts are dated to the same year, *Rīm-Sîn* year 31, while the fifth is undated. In this study, numerical values can play an important role in attributing texts to a single scribe. With Riftin 1937: no. 114, Riftin 1937: no. 115 and Riftin 1937: no. 116 a centesimal system (described in Chap. 2) is used to count men. Calculation is also similar: MAH 15886+16295, Riftin 1937: no. 114 and Riftin 1937: no. 116 all use a similar method to estimate labor costs while it is suggested that all five texts of this archive estimate both amounts of earth to be excavated and the costs of these excavations. Thus, it is safe to attribute calculations and even the tablets and texts found on NBC 11509, MAH 15886+16295, Riftin 1937: no. 114, Riftin 1937: no. 115 and Riftin 1937: no. 116 to one unnamed individual, scribe I here.

Sometimes linking texts together is more tenuous. Two texts, YBC 07310 and YBC 07187, are attributed to scribe E who was active in the grain storage bureau during *Rīm-Sîn*'s sixth year in power. Proximity of dates as well as their attribution to the grain storage bureau combined with a misspelling of the verb *erēbum*, 'to enter', are the chief arguments that these texts were authored by one scribe.

This study also shows the ability to attribute texts to a particular scribe based on calculations and, more importantly for the purposes of this study, the nature of discrepancies produced by scribes in pursuit of calculations. LB 1074 and LB 1078 are exemplary of this, as are Ashm 1922-277 and Ashm 1923-340. LB 1074 and LB 1078 were both produced in the same year, *Rīm-Sîn*'s 38th year in power and both belong to what is described as the grain harvest archive. Thus, they have similar subject matter. In addition layout is similar. Finally, with Ashm 1922-277 and Ashm 1923-340 both attributed to *Hammu-rābi*'s 35th year in power and both attributed to the grain production archive, the layout of numbers suggests calculation was carried out in a similar manner (see Sect. 6.2.3). Thus, a study of discrepancy and mathematical processes in texts can help determine a scribe's own hand, which can be difficult to detect otherwise, especially when archaeological data is missing.

It must be made clear as well that not all archives are complete here. The goal of this work is not to produce complete archives for each individual, but to describe error, as well as rounding, and then how this can help understand the calculations carried out by each scribe as well as what this tells us about education where the scribe was active. Thus, only texts that bear on this subject are studied here.

2.A Scribe A

Chronological organization of texts:

YBC 04224	*Gungunum* of Larsa?

The author of YBC 04224 is not stated but is possibly the merchantoverseer or one of his representatives, of an unstated town, possibly Larsa or a town in its vicinity. This text was probably produced during the reign of *Gungunum* of Larsa who reigned from about 1932 to 1906 BCE, as suggested by Stol 1976: 180. Stol's suggestion is based on prosopographic and geographic links to YBC 04235 which dates to *Gungunum*'s 21st year (1912 BCE).

The many references to various standards suggest familiarity with conversions between standards (see Chap. 7). The merchant who wrote YBC 04224 probably measured grain using a measuring vessel as is suggested by the phrase '2(u) ^{giš}ba-an 1(u) na$_4$-lugal', '20 *ban*-standard vessel 10 royal weight' in YBC 04224 line 42 (see Chap. 7). The use of a standard metrology would have been learned in the early stage of a scribe's mathematical upbringing, possibly with memorization of metrological lists. In lines 10 and 25 sag il$_2$-la-bi is used to state oversight by sample measurement and change rate calculation, as suggested in Sect. 7.1.3. In line 10 this term qualifies silver while in line 25 it qualifies sesame.

The actor in this text performs various additive operations as well as equivalencies between capacity and weight. To simplify calculation, the author rounds a value of sesame, measured in capacity, down before making an equivalency to silver measured in weight (Sect. 8.2). The author is prone to mistakes, one of which is a simple epigraphicmistake while the others seem to result from mistakes while using a kind of abacus (for which see Chap. 6).

Much of this text revolves around the use of grain and weight systems for calculation and measurement. Indeed, because this is a balanced account, calculation of measurement value is by addition and subtraction. This metrology was possibly learned early in the scribe's education using simple tabular lists. However, equivalencies are made and change rates are calculated, which suggests transformation from measurement value to SPVN as well as the memorization of numerical tables like multiplication tables and reciprocal tables. Equivalencies and change rate calculations would have been learned in an advanced phase of education, perhaps in a professional environment.

2.B *Lu-igisa*—Bureau of Irrigation and Excavation

Chronological organization of texts:

NBC 05474	*Sūmû-el* of Larsa year 14, month 07
NBC 05410	*Sūmû-el* of Larsa year 15, month 09
NBC 09050	*Sūmû-el* of Larsa year 16, month 03
NBC 06339	*Sūmû-el* of Larsa year 16, month 07, day 02
NBC 05506	*Sūmû-el* of Larsa year 16, month 01

Lu-igisa is treated by Walters in his 1970 monograph. Only texts discussed in this volume are stated above due to the number of texts attributed to him by Walters. *Lu-igisa* was active, during the reign of *Sūmû-el*, although his exact location is uncertain. *Lu-igisa* was an administrator at various positions in his career summed up as follows:

> The role of Lu-igisa remains unclear in all of this, as does that of Banum (who figures in twelve tablets). It seems possible to trace a shift in his position from that of landowner or mesne lord (1, 44) to that of a "canal contractor" (24, 36), to a position in the administration itself (32, 35:5'-9', 37, 38) Perhaps some of these duties were combined. 66:21–23 suggests that Lu-igisa was an "archivist" for the bureau (Walters 1970: 146).

As with many actors in the texts presented here, he can cross the line between bureau administrator, household administrator (Walters''mesne lord') and merchant intermediary (canal contractor) at different points in his career. The texts here show a certain level of conformity of quantities. The author of NBC 05474 rounded down to 47 2/3 *sar* from 47 5/6 *sar* perhaps simply out of a personal preference when it comes to volume and brickage. He preferred to work with half and third *sar* measurement values in totals rather than with sixth *sar* values, even if he was capable of working with these values (see Chap. 9). In addition, the author of NBC 06339 truncates brick quantities, perhaps out of a desire to state a more certain value.

Lu-igisa worked with measured values that he probably learned in the elementary phase of scribal education. He was adept with capacity measurement values, weight, volume and brickage. The first three systems were probably learned in the elementary phase of scribal education with lists and tables. The later, brickage, is less certain. As Middeke-Conlin (forthcoming c) points out, there were two systems to account for brickage, neither of which is visible in the extant elementary scribal education. This points to a kind of professional education, at least in part.

Lu-igisa, acting in the reign of *Sūmû-el* who reigned between 1894 and 1866 BCE, is one of the earliest actors described in this volume. He has a specialized vocabulary as is clearly visible in NBC 09050 that also seems to be derived from an independent educational tradition. This specialized vocabulary as well as a tendency toward standard values with brickage and volume suggests that *Lu-igisa* may have received additional training in a professional setting beyond the elementary level.

2.C Scribe B

Chronological organization of texts:

YBC 04761	*Nur-Adad* year C, month 10, day 04

The unnamed author of YBC 04761 acts as a merchant, possibly in Ur during the reign of *Nur-Adad* (1865-1850 BCE). He carries out a simple additive operation. However, mention of na_4-dam-gar_3'merchant weight' suggests familiarity with different measurement standards and an ability to manipulate these standards. Moreover, line three suggests the possibility that the author is evaluating cheese in silver when silver is not actually present or that he purchased the cheese after computing value in silver, both of which would point to his ability to carry out equivalency calculation. He is then probably familiar with both conversions between standards as well as equivalencies between metrological and numerical systems (see Sects. 7.1 and 8.2 respectively). The author of this archive calculates using weight. He is thus at least familiar with weightlists presented early in the scribal education, as well as probably metrological and numeric tables learned in this education as well. However, to say more is difficult based on this text.

2.D *Ilšu-ibbišu*

—dingir-*šu-i-bi-šu*: Ashm 1923-329: 2; Ashm 1924-454: 4; NBC 08014: 4; YBC 04827: 2
ugula $geme_2$ uš-bar, YBC 06147: 28; YBC 06153: 22
son of ^{d}nin-si-an-na-me-du, ir_3 ^{d}nin-si-an-na, YBC 06153: sealing
gudug: YBC 05517:15
gudug ^{d}Ištar: YBC 05723: 18

Chronological organization of texts:

Ashm 1923-329	No date
NBC 08014	*Sîn-iddinam* of Larsa year 06, month 11, day 15
YBC 04827	*Warad-Sîn* of Larsa year 04, month 12
YBC 06153	*Warad-Sîn* of Larsa year 10, month 12
YBC 06147	*Warad-Sîn* of Larsa year 11, month 04
Ashm 1924-454	*Rīm-Sîn* of Larsa year 01, month 06, day 06
YBC 05517	*Rīm-Sîn* of Larsa year 02, month 03, day 08
YBC 05723	*Rīm-Sîn* of Larsa year 07, month 12

Ilšu-ibbišu is one of the earliest scribes studied here, appearing from *Sîn-iddinam*'s sixth year until possibly *Rīm-Sîn*'s seventh year (1844-1816 BCE), if the latest three texts describe the same individual, with much of his activity in *Warad-Sîn*'s reign and perhaps *Rīm-Sîn*'s reign as well. If all texts refer to the same person then he oversees women weavers, possibly for the temple of Inanna at Ur, if the personal names referring to the god *Sîn* and his designation as gudug priest of Inanna in the last text are significant.

Ilšu-ibbišu, the author of NBC 08014, acting as a merchant produces an equivalency that involved rounding of some form or another (Sect. 8.2). *Ilšu-ibbišu* carries out a calculation of value using a metrological table of weights learned early in the scribal education. This is especially clear if he is rounding based on SPVN rather than measurement value as suggested in Chap. 5. If so, he also uses multiplication tables memorized during his mathematical upbringing. By calculating equivalencies, he shows evidence for an advanced, possibly professional, scribal education.

2.E Scribe C

Chronological organization of texts:

LB 1092	*Rīm-Sîn* of Larsa?

This unnamed scribe, author of LB 1092, of uncertain provenance and possibly dating to the reign of *Rīm-Sîn* (1822-1763 BCE), as a household administrator performs both a simple addition of capacity measurement values as well as an equivalency between silver measured in weight and grain measured in capacity. In addition, the total grain value appears in SPVN rather than capacity, suggesting an additional calculation, a multiplication or division by means of multiplication by a reciprocal was going to be carried out. The author of this archive calculates using capacity and weight measurement values.

2.F Scribe D

Chronological organization of texts:

LB 1091	*Rīm-Sîn* of Larsa?, month 04, day 26

The unnamed scribe of LB 1091, of uncertain provenance and possibly dating to the reign of *Rīm-Sîn* (1822-1763 BCE), acting as a household administrator uses only addition of capacity measurement values based on metrological lists

memorized early in his education. Evidence for this addition is perhaps found in the use of space for a scratch pad, where partial-SPVN appears as well as several erasures (see Chaps. 5 and 6 for this).

2.G *Gimillum*—Grain Storage Bureau

—*gi-mi-lum*: YBC 04740: 9, 16, 37; YBC 04747, iv 28; 217: II 7, 40, III 28; YBC 07099: 29; YBC 07708: 24
di-kud, YBC 05855: 30
giri$_3$, Riftin 1937: no. 051: 12; Riftin 1937: no. 052: 19; YBC 05494: 14; YBC 05586: 6, 15, 17, 31, 44; YBC 07473: 54’

Chronological organization of texts:

Group a	
YBC 04747	*Warad-Sîn* of Larsa year 02, month 12
YBC 05586	*Warad-Sîn* of Larsa year 04, month 04, day 10
Group b	
YBC 07473	*Rīm-Sîn* of Larsa year 04, month 01, day 29
YBC 05494	*Rīm-Sîn* of Larsa year 06, month 03, day 29
(Erm—) Riftin 1937: no. 051	*Rīm-Sîn* of Larsa year 06, month 04, day xx
YBC 08758	*Rīm-Sîn* of Larsa year 07, month 10, day 01
(Erm—) Riftin 1937: no. 052	*Rīm-Sîn* of Larsa year 08, month 10, day 02+
Group c	
YBC 07261	*Rīm-Sîn* of Larsa year 22, month 12, day14
YBC 07708	*Rīm-Sîn* of Larsa year 23, month 07
YBC 05855	*Rīm-Sîn* of Larsa year 23, month 09
YBC 07099	*Rīm-Sîn* of Larsa year 29, month 12, day broken
YBC 04740	*Rīm-Sîn* of Larsa year 30, month 02, day11

Gimillum as an actor appears among multiple text groups, probably compiled by several scribes based on the spelling of his name which appears variously as *gi-mil-lum* (Ashm 1922-303: 9), *gi-mi-il-lum* (son of Ur-^{d}a-tuk-tuk, YBC 04275: 24), *gi-mi-il$_5$-lum* (Riftin 1937: no. 066: 12) and *gi-mi-lum* presented here. He is said to be the brother of *Balamunamḫe* and *Sîn-māgir* and son of *Sîn-nūr-mātim* according to Feuerherm (2004: 6–32). The scribe recording transactions for *Gimillum* in this group is possibly the author of multiple texts dating from Warad-Sîn year two to *Rīm-Sîn* year 30 with clusters of texts around the beginning of *Warad-Sîn*’s reign (1833-1831 BCE), *Rīm-Sîn*’s fourth through eighth year (1819-1815 BCE) and 22nd through 30th year (1801-1793 BCE). *Gimillum*’s career, if all texts refer to the same person, has two main phases. In the first he is a functionary of some sort and

acts as head of the grain storage bureau. However, as his merchant interests and activity as a judge increase, his role within this bureau decreases.

Texts studied here are dated to *Warad-Sîn* year 4a (1831 BCE) and *Rīm-Sîn* year eight (1827 BCE). *Gimillum* acts in multiple capacities throughout the texts. Based on the temple name in YBC 05586: 5 and the explicit mention of the temple of Inanna at Ur in Riftin 1937: no. 052 lines 5 through 8, it is suggested that he is active in Ur, perhaps overseeing activity there, even if he is based in Larsa. Indeed, YBC 05586, a summary account describing the delivery and storage of grain, is probably representative of *Gimillum*'s role as the head of the grain storage bureau. However, he is a giri$_3$ official in the grain delivery text Riftin 1937: no. 051, line 12, along with *Ubarrûm* and *Ilšu-bani*, showing downward mobility in this bureau. He is the recipient of grain in YBC 05586, lines 6, 15, 17, 31 and 44. In YBC 07473, line 54 he is responsible for an allocation of gold. Finally, in Riftin 1937: no. 052 he is responsible for the disbursement of various quantities of silver. As the main actor in YBC 05586 and Riftin 1937: no. 052, it is suggested that he is probably responsible for the production of these texts, whether as the text's author himself or as the official responsible for accounting in these texts. A third text, YBC 08758, is also attributed to him or a scribe in his employ. This connection is based on the date, *Rīm-Sîn* year seven, the appearance of *Ninnua* in both text—in YBC 08758 he is mentioned as one of several disbursements officials, in Riftin 1937: no. 052 he is a delivery agent—as well as the odd form and use of *rabûm* in both texts.

These texts offer insights into record keeping practices in the Old Babylonian period. YBC 05586, in particular, offers insights into measurement practices and shipping. In this text, a balanced account dated to *Warad-Sîn*'s tenth year, there is inconsistency between the amounts shipped and the amounts disbursed and delivered in the third transaction. This is underlined by the stated discrepancy between the amount shipped and the amount received after deductions are made, which is described by the word la'u$_4$, 'arrears', in lines 26, 38 and 47. He is acting in this text as a merchant on behalf of a bureau, possibly the grain storage bureau discussed above. Indeed, he is probably acting as bureau head in this text, even while he carries on his own enterprises as a merchant.

YBC 08758 shows a truncation of an added value that produces a relatively large difference, 2.22 per cent (see Chap. 9). Moreover, there are three equivalencies used to produce values in this text, albeit without stated rates, in which counted items are evaluated with silver equivalents stated in weight. Riftin 1937: no. 052, also associated with this author, adds together silver assessed by weight, incorporating one broken silver equivalency into the total. *Gimillum* is thus familiar with metrological tables of weight and capacity and can add and subtract using these measurement values. He is familiar with measurement practices at least with grain and aware of measurement inconsistency. The silver equivalencies mentioned above show familiarity with multiplication tables and reciprocal tables, as well as an advanced perhaps professional education.

2.H *Itti-Sîn-milki*

—*it-ti-*[d]Sîn-*mil-ki*: AO 08460: 13; AO 08464: 33; AO 08479: 19; AO 08500: 3; AO 08506: 6; YBC 05726: 20; YBC 07473: 61'

ugula-dam-gar$_3$ *zar-bi*$_2$*-lum*[ki], AO 08469: 8; AO 08481: 11; AO 08497: 3; YBC 07473: 21

Chronological organization of texts:

YBC 05726	*Warad-Sîn* of Larsa year 12, month 09, day 25
YBC 07473	*Rīm-Sîn* of Larsa year 04, month 01, day 29
YBC 05584	*Rīm-Sîn* of Larsa year 10, month 11
AO 08481	*Rīm-Sîn* of Larsa year 22, month 03
AO 08500	*Rīm-Sîn* of Larsa year 22, month 06, day 12
AO 08469	*Rīm-Sîn* of Larsa year 22, month 07, day 25
AO 08479	*Rīm-Sîn* of Larsa year 22, month 09
AO 08506	*Rīm-Sîn* of Larsa year 23, month 04, day 30
AO 08497	*Rīm-Sîn* of Larsa year 23, month 06, day 05+
AO 08460	*Rīm-Sîn* of Larsa year 25, month xx, day 05
AO 08464	*Rīm-Sîn* of Larsa year 27, month 11

Itti-Sîn-milki, active between *Warad-Sîn* year 12 and *Rīm-Sîn* year 27 (1823-1796 BCE), is possibly the author of two texts in this study out of eleven texts that mention him. If not him then a scribe in his employ is the author while he is the main actor of these two texts. As the merchant overseer at *Zarbilum*, it is suggested that he performed the mathematical operations which resulted in these texts. The earlier of the two texts, YBC 07473, offers evidence for how this scribe coped with non-regular numbers, that is numbers which had no finite reciprocal as far as the Old Babylonian scribes were concerned (Sect. 8.2.3). In addition, the author of YBC 07473 rounds based on entries in metrological tables. Because this is a balanced account, he carried out both additive and subtractive operations in conjunction with equivalencies. These equivalencies required multiplication and multiplication by a number's reciprocal to carry out.

YBC 07473 from the *Itti-Sîn-milki* archive is closely tied to AO 06760, an account from the *Ubār-Šamaš* archive. The capital section of AO 06760 relates the same exact capital statements as the first two capital statements of YBC 07473. However, disbursements are significantly different. One wonders whether *Itti-Sîn-milki* took over an old account, whether he used *Ubār-Šamaš* as an agent or whether these capital sections represent a standard capital disbursement around this time. AO 08464 possibly offers evidence for rounding. However, there is significant difficulty with this text so that the nature of the discrepancy is uncertain: is it the result of an ancient hand or modern? The rates in AO 08468 show conformity, possibly based on SPVN.

Thus, *Itti-Sîn-milki* is a very skilled scribe. He certainly memorized his metrological lists and tables as well as numerical tables in the elementary phase of his scribal education. His advanced phase of education, perhaps a professional education, dealt at a minimum with the calculation of equivalencies. Practice with the reciprocals of non-regular numbers probably occurred at some point late in his elementary education or in his advanced education.

2.I *Šamaš-aššu-aplu*—Bureau of Irrigation and Excavation

—^{d}Šamaš-*aš-šu-ap-lu*: YBC 04721: 9, 14

Chronological organization of texts:

YBC 04721	*Rīm-Sîn* of Larsa year 01, month 01, day 07

The author of this archive consisting of only one text in this study that is dated to *Rīm-Sîn* year 01 (1822 BCE) uses atabular array to organize data for several additive operations. Mention of Larsa and Ur suggests that the author of this document was from one of these cities or their vicinity. The tablet's shape and layout are remarkably similar to those seen later in the bureau, especially NBC 11509and Riftin 1937: nos. 114–116. However, the date of YBC 04721 compared to the date of Riftin 1937: nos. 114–116 suggests a different scribe was active at this time, although this is by no means certain. Moreover, content seems to be allocating resources to a series of large projects in a series of cities, not simply one project with several contractors. The scribe authoring YBC 04721 is possibly the head of the bureau of irrigation and excavation at the time of the text's writing, *Rīm-Sîn* year one.

The author carries out an additive operation in grain measured in capacity. The scribe adds values using metrological lists memorized in the very earliest period of his mathematical upbringing.

2.J *Nabi-Šamaš* A—Bureau of Irrigation and Excavation

—*na-bi-*^{d}Šamaš: LB 1837: 24; YBC 06306: 1
ugula Amurru: Ashm 1922-281
son of *a-di-ia-tum*: Ashm 1922-300: 10

Chronological organization texts:

LB 1837	No date
Ashm 1922-300	*Rīm-Sîn* of Larsa year 01, month 09, day 12
Ashm 1922-281	*Rīm-Sîn* of Larsa year 01, month 09, day 14
YBC 06306	*Rīm-Sîn* of Larsa year 24, month 09

Nabi-Šamaš is considered here the author of Ashm 1922-281 (Dated to 1822 BCE), a tabular list that exhibits a mix of centesimal and sexagesimal numbers to quantify men. The use of a centesimal system suggests a possible link to the bureau of irrigation and excavation. Here, the total is presented in the sexagesimal system S while each quantity of men in lines 1 through 31 is represented in the centesimal system (see Chap. 2 for both systems). Multiple mentions of Larsa in Ashm 1922-281, the title given to *Nabi-Šamaš,*'overseer of Amorites', as well as Ashm 1922-281's association with the bureau of irrigation and excavation suggest a central location, possibly Larsa itself. The author of Ashm 1922-281, as overseer of Amorites, is perhaps also a merchant overseeing day to day costs of excavations. He is thus an outsider to the bureau acting on contract for the bureau.

The author carries out an additive operation incorporating quantities of men and then a second operation on grain measured in capacity. Each quantity in the text also represents a wage calculation where the author multiplied a wage rate in grain by an amount of men, sometimes adding an additional quantity perhaps for an overseer, to produce a total in grain. The totals in grain and men were added together. There are multiple discrepancies in this text, although their exact natures are not certain due to breaks in the text. However, in column 3 line 32 there is a truncation that results in a 0.14 per cent difference (see Chap. 2 for this).

The author is able to work with capacity and counted items, but also learned how to manipulate numbers using the centesimal system as well, reflecting specialized knowledge localized to the bureau of irrigation and excavation. He calculates wages by means of multiplication which shows he also memorized numerical tables in the elementary phase of his scribal education and he is able to work with wage rates showing continued education into an advanced phase of scribal education. This phase may have been in a professional setting and may have been partially located within the bureau of irrigation and excavation itself. This latter is suggested by Ashm 1922-281's presentation as a tabular list and the use of the centesimal system to quantify men. Thus, part of his education may have been similar to that received by scribe I, *Immer-ilī*, and scribe Q of the bureau of irrigation and excavation.

2.K *Šulpae-nāṣir* and *Ilī-ippalsam*

Ilī-ippalsam

—*i$_3$-li$_2$-ip-pal-sa$_3$-am*, gu$^!$-za-la$_2$: Ashm 1922-337: 6$^?$
dam-gar$_3$, Ashm 1922-336: 6
—*i$_3$-li$_2$-ip-pal-sa$_3$-am*, YBC 04751: 36; YBC 05087: 5
gu-za-la$_2$: Ashm 1922-316: 5
son of ^{d}Sîn-[…]: Ashm 1922-316: sealing

Chronological organization of texts:

Ashm 1922-337	*Rīm-Sîn* of Larsa year 01, month 08, day 24
Ashm 1922-316	*Rīm-Sîn* of Larsa year 01, month 09, day 01
Ashm 1922-336	*Rīm-Sîn* of Larsa year 01, month 09, day 19
YBC 05087	*Rīm-Sîn* of Larsa year 34, month 08
YBC 04751	*Rīm-Sîn* of Larsa year 37, month 01

Šulpae-nāṣir

—^{d}šul-pa-e$_3$-na-ṣir: Ashm 1922-316: 7

dam-gar$_3$, Ashm 1922-336: 5

Chronological organization of texts:

Ashm 1922-316	*Rīm-Sîn* of Larsa year 01, month 09, day 01
Ashm 1922-336	*Rīm-Sîn* of Larsa year 01, month 09, day 19

Šulpae-nāṣir and *Ilī-ippalsam* appear together in two texts: Ashm 1922-316 where *Šulpae-nāṣir* is listed as the partner (*tab-bi-šu*) of *Ilī-ippalsam* the chair bearer, while in Ashm 1922-336 they are described as merchants. Both texts date to *Rīm-Sîn*'s first year in power (1822 BCE). *Ilī-ippalsam*'s name is spelled in two manners in these two texts, suggesting two different scribes wrote these two texts, although the main actors probably carried out any mathematical operation or measurements.

While *Šulpae-nāṣir* is poorly represented in the texts, *Ilī-ippalsam* appears in several texts ranging from *Warad-Sîn* year nine to *Rīm-Sîn*year 37. These appear in two clusters with three texts appearing in *Rīm-Sîn*'s first year and two texts appearing in the middle of *Rīm-Sîn*'s reign, years 34 through 37. Thus, there are possibly two *Ilī-ippalsam*'s, one at the beginning of *Rīm-Sîn*'s reign and one operating in the middle of this king's reign, while a third appears during the reign of *Hammu-rābi* of Babylon.

Ashm 1922-336 explicitly states a verification of grain measure. *Sanāqum* is used in line 4 as 'to check weight' and denotes a form of oversight (see Chap. 7 for this). In addition, an equivalency is made between capacity and weight measurement values. The rate is a simple one to one calculation, both 3 *ban* and 1/2 *gin* transform to 30 in SPVN so that an equivalency would have required little effort by the author of this text were he familiar with the metrological tables. Thus, the author of Ashm 1922-336 is familiar with measurement inconsistency probably learned early in his education when he memorized the metrological lists. He is also familiar with transformations between measurement values and SPVN which would have been learned with metrological tables during his elementary education as well. Finally, he is familiar with basic equivalency calculations which he would have learned in an advanced, perhaps professional, phase of his scribal education.

2.L *Ubār-Šamaš*—Grain Storage Bureau

—*u-bar*-^{d}Šamaš: AO 06760: 60; YBC 05829: 16
giri$_3$, AO 06760: 52
son of dingir-*ba-ni*AO 06760: 10
ugula-dam-gar$_3$, Riftin 1937: no. 052: 10; Riftin 1937: no. 066: 2

Chronological organization of texts:

(Erm—) Riftin 1937: no. 066	*Rīm-Sîn* of Larsa
AO 06760	*Rīm-Sîn* of Larsa year 02, month 05, day 30
YBC 05829	*Rīm-Sîn* of Larsa year 06, month 05
(Erm —) Riftin 1937: no. 052	*Rīm-Sîn* of Larsa year 08, month 10, day 02+

Texts produced by this scribe who is active between 1821 and 1815 BCE describe both evaluations and expenditures in silver as well as evaluations and expenditures in grain. The group centers around *Ubār-Šamaš*, a merchant and perhaps head of the grain storage bureau at the time of YBC 05829's writing. Another *Ubār-Šamaš*, who is the son of *Ilī-išmeanni*, not of *Ilum-bani* as seen here, is treated by Feuerherm (2004: 4–50). *Ubār-Šamaš*, the merchant overseer in Riftin 1937: no. 052, is probably *Ubār-Šamaš*, the son of *Ilum-bani*, who is discussed here because in AO 06760 he receives capital similar to that in YBC 07473, which is also attributed to a merchant overseer, *Itti-Sîn-milki*. It's not certain whether YBC 07473 and AO 06760 both refer to the same transaction which was taken over in YBC 07473 or whether they refer to a standard disbursement from the palace. However, in either case, these disbursements are probably both distributed to the merchant overseer of each community and thus suggest both actors would be a merchant overseer.

As shown in YBC 05829, he is active in the grain storage bureau and he is clearly a merchant overseer. This is further underlined by his activities in AO 06760. This shows that officials acting in this bureau were or could be merchants.

This makes much sense with *Ubār-Šamaš*. As a merchant overseer he would have worked with excess crown capital while the storage and expenditures of capital, including grain for labor, would have been within his purview as well (see Chaps. 1, 3 and 4 for this).

Another merchant, *Ṣillī-Šamaš* appears in both texts (AO 06760: 57 and YBC 05829: 9, cf. discussion in Sect. 2.P, this appendix) but as a recipient in both texts. This suggests that these two texts form a distinct group, perhaps related to those texts of *Ṣillī-Šamaš* discussed below (Appendix 2.P). However, this is the only merchant and name held in common through both texts which is to be expected: AO 06760 is a silver text and YBC 05829 is a grain disbursement text. They would have recorded different communities. AO 06760 refers to merchants and the wealthy, YBC 05829 to labor and merchant intermediaries in labor allocation and oversight.

Ubār-Šamaš is probably from in or around Larsa based on his affiliation with the merchants mentioned above, as well as details found within the texts themselves. This would help to confirm that the grain storage bureau and facilities were located in Larsa as suggested by Breckwoldt (1995/1996: 66), even if exact provenance within the city cannot be provided. Moreover, like *Gimillum*, he is also active in Ur as is shown by YBC 05829. Thus, these two texts show that the author is a relatively important actor, a merchant intermediary administering Larsa's economy and active in multiple locations.

The scribe who produced these texts worked in both weight and capacity measurement values and was able to make equivalencies between weight and weight as well as capacity and weight by means of multiplication and division via multiplication by a number's reciprocal (AO 06760), in addition to basic additive operations of capacity measurement values (YBC 05829) and weight measurement values (AO 06760). He is thus well acquainted with metrological and numeric tables learned in the elementary phase of the scribal education and went on to an advanced, possibly professional phase of this education.

2.M Scribe E—Grain Storage Bureau

Chronological organization of texts:

YBC 07310	*Rīm-Sîn* of Larsa year 06, month 03, day 29
YBC 07187	*Rīm-Sîn* of Larsa year 06, month 04, day 04

Scribe E is considered a delivery agent for the grain storage bureau. The texts presented under scribe E, YBC 07310 and YBC 07187, both mentioned in Chap. 7, are grain delivery texts dated to *Rīm-Sîn* of Larsa's sixth year (1817 BCE). The author of this archive deals with the same community: *Apil-Sîn*, *Ea-nāṣir*, *Nūr-Amurru*, and *Sîn-qāti-ṣabat*. He distinctly uses the word *i-ru-bu*, the G-preterit plus subordinate marker of *erēbum*, 'to enter' in order to describe entrance of grain into

a granary. In addition, he distinctly omits the phrase mu-ku$_x$(DU) u_3 ba-zi which defines the rest of the bureau archive. The two texts he produces show an understanding of measurement inconsistency and then familiarity with metrological lists of capacity learned early in the elementary scribal education.

2.N Uncertain Scribes—Grain Storage Bureau

Chronological organization of texts:

YBC 05494	*Rīm-Sîn* of Larsa year 06, month 03, day 29
(Erm—) Riftin 1937: no. 051	*Rīm-Sîn* of Larsa year 06, month 04
YBC 06663	*Rīm-Sîn* of Larsa year 06, month 04, day 10
YBC 06985	*Rīm-Sîn* of Larsa year 07, month 04, day 06

YBC 05494 (1817 BCE), Riftin 1937: no. 051 (1817 BCE), YBC 06663 (1817 BCE) and YBC 06985 (1816 BCE) are all discussed in Chap. 7 and all lack any distinction between scribes. However, it can be stated that while there is no ability to make a distinction between scribes, this also points to standard record keeping practices within this bureau. Grain was calculated in the same manner throughout, vocabulary was similar, so that distinction between scribes can only be made by abnormalities in vocabulary or the appearance of personal names with a defined perspective, and not by procedure. As stated in Sect. 4.1 while discussing this bureau, these texts probably come from the city of Larsa itself. The authors of each text were all aware of measurement inconsistency learned with metrological lists during the elementary phase of scribal education. Calculations are carried out using capacity measurement values.

2.O *Sîn-māgir*—Grain Storage Bureau

—^{d}Sîn-*ma-gir*: AO 06763: 4; AO 07034: 4; Riftin 1937: no. 054: 4; YBC 07195:35

Chronological organization of texts:

YBC 07195	*Rīm-Sîn* of Larsa year 06, month 12
AO 06763	*Rīm-Sîn* of Larsa year 07, month 10
AO 07034	*Rīm-Sîn* of Larsa year 12, month 10
(Erm —) Riftin 1937: no. 054	*Rīm-Sîn* of Larsa year 13, month 04, day 22

As stated in Sect. 4.1, all texts attributed to the grain storage bureau were probably produced within the city of Larsa itself so that it's likely that *Sîn-māgir* comes from Larsa as well. Indeed, as noted by Feuerherm (2004: 6–42), *Sîn-māgir* could be one of many people of the same name within the city of Larsa, in addition to those abroad. The texts presented here, however, are by and large easily attributed to one individual due to the content of each: Riftin 1937: no. 054, AO 07034 and YBC 07195 all refer to grain shipment and involve actors and places as seen throughout the grain storage bureau. This *Sîn-māgir* is active as a delivery agent for the grain storage bureau between 1817 and 1810 BCE, overseeing local agricultural activity (YBC 07195) and deliveries (AO 06763 and Riftin 1937: no. 054).

This scribe helps to expand upon the activities of the delivery agents active in the grain storage bureau. AO 07034 as well as Riftin 1937: no. 054 are typical of this bureau in that they present evidence for measurement of grain before and after shipment showing familiarity with measurement inconsistency, as well as an additive and subtractive operations. YBC 07195 presents an additive operation as well, in addition to the calculation of wages. 30 *gur* is the grain rations of 6 ox drivers, suggesting a rate of 5 *gur* grain per driver. Note also a mistake in YBC 07195. The scribe who authored these texts was thus versed in metrological lists and tables for capacity as well as numerical tables learned in the elementary phase of scribal education and wage calculation learned in an advanced phase of education.

2.P *Ṣillī-Šamaš*—Grain Storage Bureau

—*ṣi-li-*^{d}Šamaš: AO 06760, 57; YBC 05568: 2; YBC 05580: 4; YBC 06231: 3; YBC 07190: 5$^{?}$; YBC 07194: 3; YBC 07211: 30; YBC 08761: 4
giri$_3$, YBC 05586: 12, 27
dumu *si-mu-ug*$_2$*-ra*, YBC 05829: 9; YBC 06143: 12; YBC 07185: 7

Chronological organization of texts:

YBC 05586	*Warad-Sîn* of Larsa year 4a, month 04, day 10
AO 06760	*Rīm-Sîn* of Larsa year 02, month 05, day 30
YBC 06143	*Rīm-Sîn* of Larsa year 06, month 04, day 30
YBC 05829	*Rīm-Sîn* of Larsa year 06, month 05
YBC 07185	*Rīm-Sîn* of Larsa year 06, month 12, day 6+
YBC 05568	*Rīm-Sîn* of Larsa year 07, month 09
YBC 05580	*Rīm-Sîn* of Larsa year 07, month 11
YBC 07211	*Rīm-Sîn* of Larsa year 07, month 12
YBC 08761	*Rīm-Sîn* of Larsa year 07, month 13, day 06
YBC 06231	*Rīm-Sîn* of Larsa year 08, month 03, day 13
YBC 07190	*Rīm-Sîn* of Larsa year 09, month 09, day17
YBC 07194	*Rīm-Sîn* of Larsa year 12, month 05, day 25

Ṣillī-Šamaš is a very active official in the grain storage bureau between 1831 and 1811 BCE. He acts as a conveyor under *Gimillum*, receives grain from *Ubār-Šamaš* and acts as a delivery agent in YBC 07194, YBC 05580 and YBC 06231, all discussed in Chap. 7. Whether authored by *Ṣillī-Šamaš* or another scribe, these texts show a distinct preference to keep accountability of the delivery agent which is not a normative practice of this bureau and thus bears witness to another distinct scribe active in the grain storage bureau. Note that *Awīl-Ninšubur* is spelled with final –ka in YBC 06231 and without a final –ka in YBC 07194. The difference in years (*Rīm-Sîn* year eight and year twelve) allows for two possibilities: either two scribes are presented here who learned to spell this name differently or there is one scribe who did not hear a final –ka when delivery was made in the first text but did hear it in the latter text. As records for the grain storage bureau, these texts probably come from the city of Larsa itself.

The scribe here works with capacity measurement values: in each text a measurement is made before shipment and after delivery, a standard practice in the grain storage bureau. YBC 07194, line 8 is very interesting in this regard in that it makes explicit that a capacity standard differed from one place to another. The scribe probably carried out a sample measurement and then change rate calculation in order to estimate the change between standards. Interestingly, the fact that he truncates—to *sila* in this case—as well as the large percent error suggest he is aware ofmargins of error and wanted to maintain transparency in this text (see Sects. 7.1.3 and 7.5 for this). The scribe is able to make conversion between standards, which points to multiplication as well as division by means of multiplication by a reciprocal. In addition, remeasuring is carried out and the difference between sent and delivered grain written down. This points to his awareness of measurement inconsistency. Finally, additive and subtractive operations are carried out directly in this text. Thus, the scribe was familiar with both metrological lists and tables as well as numeric tables learned in the elementary stage of the scribal education, along with standard conversions learned in an advanced, professional phase of scribal education.

2.Q *Sîn-errēš*—Grain Storage Bureau

—^{d}Sîn-ereš$_{4}$: YBC 08774: 2
lu$_{2}$ umma^{ki}: YBC 05586: 7

Chronological organization of texts:

YBC 05586	*Warad-Sîn* of Larsa year 04, month 04, day 10
YBC 08774	*Rīm-Sîn* of Larsa year 07, month 05, day 06

There are many persons named *Sîn-errēš* dated to the Old Babylonian period (cf. for instance, the multiple mentions of this figure in the personal name index to Grice 1919 found on page 35). The *Sîn-errēš* discussed here is a delivery agent for the grain storage bureau in two texts of this study: YBC 08774 (1816 BCE) where he is the main actor working through *Lāqipum* and *Imgur-Sîn*, as well as YBC 05586 (1831 BCE), line 7, where he appears in one transaction of many in which *Gimillum* is the recipient. As stated above, all texts attributed to the grain storage bureau were probably produced within the city of Larsa itself so that *Sîn-errēš* is probably active in Larsa as well. Indeed, connection to *Gimillum* renders this more likely.

As part of the grain storage bureau, the scribe in question works with capacity measurement values: an additive and subtractive process is visible where the scribe both adds the total expenditures in his account and subtracts this total from the quantity delivered to find a difference between the two. This difference offers evidence for a measurement before delivery and after receipt, which in turn shows an awareness of measurement inconsistency and capacity metrological lists learned in the elementary phase of scribal education.

2.R Scribe F—Grain Storage Bureau

Chronological organization of texts:

YBC 07211	*Rīm-Sîn* of Larsa year 07, month 12
YBC 07308	*Rīm-Sîn* of Larsa year 09, month 01, day 17
YBC 05768	*Rīm-Sîn* of Larsa year 09, month 07, day 10
YBC 06216	*Rīm-Sîn* of Larsa year 09, month 10, day 05
YBC 07313	*Rīm-Sîn* of Larsa year 10, month 03, day 09

The scribe who produced these texts was probably active in the grain storage bureau between 1816 and 1813 BCE. This is suggested by the cities mentioned in YBC 07211 and YBC 05768, the disbursements from the various granaries used as storage facilities in YBC 07308 and YBC 05768, as well as the similar subject matter: disbursements of grain are mentioned in each document, for transport of bricks in YBC 07211 and YBC 07308 as well as for straw possibly used in brick production in YBC 05768.

In several texts, withdrawals (*maššartum*) are for expenses described as household, although the nature of this household is uncertain—is it a private household, a bureau or something else? This is the case in YBC 05768, YBC 06216, YBC 07308 and YBC 07313. Grain in each is described as 'in the sealed storeroom of the household' ('ša$_3$ e$_2$ kišib-ba *bi-tim*' or 'ša$_3$ e$_2$ kišib-ba e$_2$'). Spelling of the verb *waṣûm* in YBC 07308 and YBC 05768 shows further possible connection between the two. The activities described in the texts suggest the author

could have been the head of the bureau or a scribe in his employ. If so, then these texts would be connected to *Ubār-Šamaš* or someone replaced *Ubār-Šamaš* as bureau head by either *Rīm-Sîn*'s seventh or ninth regnal year.

All texts in this group mention allocations of grain for various purposes. Capacity measurement values are used in each transaction as well as an additive process. In addition, the scribe in question is able to assess labor in grain which shows possible familiarity with division via multiplication by a number's reciprocal. Lists and tables of capacity as well as numerical tables of reciprocals and multiplication were probably memorized by this scribe in the elementary phase of the scribal education as well as wage rates learned in an advanced, perhaps professional phase of the scribal education.

2.S Scribe G—Possibly Grain Storage Bureau

Chronological organization of texts:

AO 07034	*Rīm-Sîn* of Larsa year 12, month 10

The unnamed author of AO 07034 (1811 BCE) is suggested to work in Larsa if he is active in the grain storage bureau. Silver equivalencies are calculated, assessing counted items and capacity measurement values by weight in AO 07034, as well as addition of these assessed weights. Thus, the scribe can both multiply and divide via multiplication by reciprocals and add weight measurement values. A discrepancy is present in AO 07034, a form of rounding. Reduction is from 26 *še* to 15 *še*. Thus, the author of AO 07034 makes use of metrological tables of weight as well as numerical tables of reciprocals and multiplication learned in the elementary phase of scribal education as well as equivalencies learned in an advanced, perhaps professional phase of his education.

2.T *Šēp-Sîn* A

Chronological organization of texts:

Ashm 1932-378	*Rīm-Sîn* of Larsa year 21, month 05

This *Šēp-Sîn* is probably not the same *Šēp-Sîn* presented below, nor even one of the two discussed in Tyborowski (2003). Here *Šēp-Sîn* is listed as either an Amorite or the son of *Awīl-Amurru*, not the son of *Sîn-muballiṭ* as seen in Stol 1982: no. 37,

nor the merchant overseer as seen in A.26371 and HE 111. Based on the text alone it is difficult to state where he comes from.

This *Šēp-Sîn*, author of Ashm 1932-378 (1802 BCE), works with capacity and weight measurement values. Addition is carried out as well as an equivalency between grain and silver value which required division via multiplication by a number's reciprocal. Thus, the author makes use of metrological tables of capacity, weight and multiplication tables learned in the elementary phase of scribal education and received some advanced, perhaps professional scribal training. Note a probable example of rounding a grain value down.

2.U Scribe H

Chronological organization of texts:

YBC 07183	*Rīm-Sîn* of Larsa year 29, month 08

Provenance for YBC 07183 (dated to 1794 BCE) and its author are difficult to state. The unnamed author performs a complex additive process in which he terminates calculation by rounding down 1/3 *sila* from the total. Equivalency is made between capacity measurements of grain and bran and counted livestock. Thus, the author can divide via multiplication by a number's reciprocal. He is then familiar with metrological tables of weight as well as numerical tables of reciprocals and multiplication learned in the elementary phase of scribal education and went on to receive some advanced, perhaps professional education.

2.V Scribe I—Bureau of Irrigation and Excavation

Chronological organization of texts:

NBC 11509	No year, month 11 day 01
MAH 15886+16295	*Rīm-Sîn* of Larsa year 31, month 06, day 02+
(Erm—) Riftin 1937: no. 114	*Rīm-Sîn* of Larsa year 31, month 06, day 30
(Erm—) Riftin 1937: no. 115	*Rīm-Sîn* of Larsa year 31, month 09, day 15
(Erm—) Riftin 1937: no. 116	*Rīm-Sîn* of Larsa year 31, month 09

Based on texts Riftin 1937: nos. 114–116 and MAH 15886+16295, this archive can be dated to around *Rīm-Sîn*'s 31st year (1792 BCE). As noted by Clevenstine (2015), two locations are described on MAH 15886+16295, the first project is effaced while the second is a construction project around *Dūr-Kudur-mabuk*. Based

on NBC 11509, the effaced name can tentatively be proposed as the bank of the *Mami-šarrat* canal in the south of the kingdom of Larsa. *Rīm-Sîn-rappašunu* is the unifying figure of these texts, although he is probably not the author. *Rīm-Sîn-rappašunu* is mentioned as the only actor in NBC 11509 and is charged with the most labor in each of the other texts.

It is suggested here that all five texts belong to the same archive and possibly the same hand. Tablet shapes and layout are very similar. Each text deals with cost and labor or earth to be excavated. NBC 11509 presents earth to be excavated. Riftin 1937: no. 115 states labor solely in the quantities of men. Riftin 1937: no. 114, Riftin 1937: no. 116 and MAH 15886+16295 present labor in the form of men, grain and days.

This entire archive possibly deals with labor that will be expended excavating and constructing canals.[8] NBC 11509 dated to month 11 is divided into six places while MAH 15886+16295 dated to month 06 enumerates six chief workers. In addition, Riftin 1937: no. 114 dated to month 06 as well lists 4 overseers and Riftin 1937: no. 116 dated to month 09 lists five overseers. Perhaps the number of chiefs and overseers differs based on the number of places to be excavated. In each text, two kinds of labor are described: MAH 15886+16295 enumerates chief workers from the street (eren$_2$ *ru-ub-bu su-qi*$_2$*-im*, column 1) and workers and foremen of ten (erin$_2$-ha$_2$ *u*$_3$ ugula nam-10, column 2) while Riftin 1937: no. 114 and Riftin 1937: no. 116 enumerate both overseers' labor (erin$_2$ ugula, column 1) and general labor (erin$_2$, column 3).

The lack of a year date on NBC 11509 suggests that it is a document used to plan and may be classified as a project statement, while the statements of men and grain in MAH 15886+16295, Riftin 1937: no. 114 and Riftin 1937: no. 116 suggest the reason for this planning: allocations of men, grain and time. These activities fall in line with the canal inspector of the bureau of irrigation and excavation described in Sect. 4.2. Thus, the scribe is likely a canal inspector, perhaps based in Larsa itself or Nippur if he is based in the same city as *Rīm-Sîn-rappašunu*, but working throughout southern Mesopotamia, evaluating canals and planning or assessing work that needs to be performed or has been and is in the process of being performed.

The author(s) of this archive calculates volume in NBC 11509 by means of a multiplication of length by width by depth to estimate earth to be excavated from a canal. This was probably performed to predict labor in man-days necessary to complete these projects by using standard labor rates. Man-days labor were in turn used to estimate wages which make use of standard wage rates: 3 *bariga* 2 *ban* for chief workers from the street, 1 *bariga* for workers and foremen of ten in MAH 15886+16259, then 6 2/3 (*sila*) for overseers and 2 *sila* for general laborers in Riftin 1937: no. 114and 116. These costs in men and grain were then estimated by month in MAH 15886+16295 and by day and by month in Riftin 1937: no. 114and 116.

[8]Against Clevenstine (2015) who proposes the construction of a fortress. However, Clevenstine was unaware of the existence of NBC 11509 at the time of his writing.

Both system S (Riftin 1937: no. 115) and a centesimal system appear (Riftin 1937: no. 114, Riftin 1937: no. 116 and MAH 15886+16295) similar to that found in Ashm 1922-281 discussed above and suggesting a possible connection between these documents.

The scribe is thus learned in metrological tables of capacity, length, height and volume as well as numerical tables of reciprocals and multiplication learned in the early phase of scribal education, as well as an advanced education involving volume and labor calculations, which suggests familiarity with labor coefficients. Part of his education could well have taken place in a professional environment as was also suggested for *Lu-igisa* above, *Immer-ilī*, scribe Q and scribe R below, as well as to a limited degree *Nabi-Šamaš* A. This is especially evident with thetabular format of each text, the use of the centesimal system in counting men, wage rates and perhaps labor rates as well. Thus, the author partakes of an elementary education in which metrological and numerical tables were memorized, as well as an advanced, perhaps partially professional education.

2.W Scribe J

Chronological organization of texts:

LB 1082	*Rīm-Sîn* of Larsa year 31, month 21, day 18
LB 1072	*Rīm-Sîn* of Larsa year 31, month 25, day 18

This archive appears in *Rīm-Sîn*'s 31st year (1792 BCE), shortly after his conquest of Isin. It is distinguished by very strange dates. An exceptional number of intercalary months are present which points to an attempt to align the calendars of various regions within the kingdom of Larsa to one particular calendar (see Van de Mieroop 1993 for a discussion of this). In addition, content is similar: each text presents household expenses and expenditures. Because of the extraordinary number of intercalary months, this archive was probably not produced within Larsa itself, but perhaps within the newly conquered kingdom of Isin.

The scribe in question works with capacity measurement values and carries out both additive and subtractive operations. In addition, there is a clear example of rounding in LB 1072 in which the author rounds up 1/2 *sila*, producing a difference of 1.7 per cent. Metrological lists of capacity were learned in the elementary phase of scribal education.

2.X Scribe K

Chronological organization of texts:

LB 2053	*Rīm-Sîn* of Larsa year 34?

The unknown author of LB 2053 (1789 BCE) presents costs in bran measured in capacity for harrowing and breaking an unknown field as well as counted quantities of cattle. Calculation is carried out using an additive procedure. An approximate production rate for producing bran out of grain suggests the use of multiplication as well as division via multiplication by a number's reciprocal. The author probably memorized metrological lists and tables as well as numerical tables of reciprocals and multiplication in the elementary phase of scribal education and then went on to some form of advanced, perhaps professional education.

2.Y Scribe L—Grain Harvest Archive

Chronological organization of texts:

LB 1074	*Rīm-Sîn* of Larsa year 38, month 01, day 29
LB 1078	*Rīm-Sîn* of Larsa year 38, month 02, day 09

The scribe who produced LB 1074 and then LB 1078 (both dated to 1785 BCE) is one of two scribes visibly active in a grain harvest archive of unknown provenance. He is probably a mid-level bureaucrat, perhaps a delivery agent working for the grain storage bureau, who is active for only one harvest overseeing activity in the fields of *Agakkum* and of *Hazazanum*.

The author of LB 1074 and LB 1078 measures grain via capacity and counts men. He performs an additive operation which results in a mistake. The author also assesses labor, stated in men(-days) in grain by means of multiplication of men by a wage rate. The amounts of grain this produced are not explicitly stated but confirmed by the subtotals in each text, which clearly incorporate these quantities. The scribe who authored LB 1074 and LB 1078 memorized metrological lists and tables of capacity as well as multiplication tables in his elementary phase of scribal education and continued to an advanced, perhaps professional education where he learned how to calculate wages.

2.Z Scribe M—Grain Harvest Archive

Chronological organization of texts:

LB 1069	*Rīm-Sîn* of Larsa year 38, month 13, day 25

Scribe M of the grain harvest archive is active eleven months after scribe L, in an intercalary month placed at the end of the year (1785 BCE). Indeed, he probably took over after scribe L's tenure in this office and, if belonging to the grain storage bureau, would have been a delivery agent. He oversees activity in the field of *Hazazanum*.

The scribe works with grain stated in capacity as well as quantities of men. He carries out an additive process and clearly rounded up the total of men. Similarities in content with the work of the other scribe active in this archive suggest he carried out wage calculations as well. That is, he multiplied each quantity of men by a wage rate to produce a total grain expended. He probably memorized metrological tables for capacity, as well as numerical multiplication tables in the elementary phase of his scribal education and went on to some advanced, perhaps professional education.

2.AA *Immer-ilī*—Bureau of Irrigation and Excavation

—*im-me-er*-dingir: NBC 06763: 17

Son of *a-pil*$_2$*-ša*: Ashm 1922-291: v 12

Chronological organization of texts:

NBC 06763	*Rīm-Sîn* of Larsa year 38, month 11, day 08
Ashm 1922-291	No date

The author of NBC 06763 (dated 1785 BE), a part of the irrigation and excavations bureau, describes several canal excavations and appears similar to NBC 11509 presented above. This bureau is marked by activity throughout the kingdom of Larsa, but it is suggested here that activity is planned in a central location, perhaps the city of Larsa itself. However, NBC 06763 clearly differs from NBC 11509 in clay quality and vocabulary. Thus, a different scribe is probably at work, operating outside of Larsa and evaluating an activity that was planned from within

the city of Larsa but at a distance. However, while this scribe is working outside of Larsa, he is probably part of the bureaucracy located in Larsa, active in this bureau and thus, educated within the city of Larsa itself.

The scribe here is not carrying out the same operations as are present with NBC 11509. Here the scribe is probably presenting observed values based on a coefficient for labor in excavations similar to those witnessed in YBC 12273. However, the total itself seems to be the result of an addition of volumes calculated by means of length by width by depth. Thus, a calculation takes place before and after excavation and volume is assessed twice in NBC 06763. This author perhaps learned similar specialized knowledge as was suggested for scribe I. Rounding by means of truncation is witnessed by the discrepancy between expected and stated total and perhaps betrays use of a counting device and preference for standard values.

The scribe here works with length and height measurement values as well as volume measurement values. In addition, multiplication by length, width and depth is suggested, although this is probably in reference to an earlier calculation and text and thus not certainly the product of this author. This all suggests memorization of metrological tables for length, height and volume, as well as multiplication tables and reciprocal tables in the elementary phase of scribal education.

However, division via multiplication of a coefficient's reciprocal is suggested so that the author is familiar with both reciprocal tables and coefficientlists, at least where labor is concerned. Because *Immer-ilī* uses atabular format and exhibits specialized knowledge similar to scribe I and scribe Q, as well as practices witnessed within the bureau of irrigation and excavation, he probably had a similar advanced, partially professional education as is suggested for *Lu-igisa* and scribe I, scribe Q and scribe R below, as well as to a limited degree *Nabi-Šamaš* A.

2.BB *Sîn-iddinam*

—^{d}nanna-ma-an-si$_3$: AO 06353: 24; AO 06371: 33; LB 1075: 5, LB 1091: 15; LB 2051: 14; LB 2052: 15; LB 2056: 2, 8; LB 2073: 24; 12; YBC 04458: 9; YBC 05709: 6; YBC 07076: 53; YBC 08759: 4, 5, 13

^{d}nanna-ma-an-si$_3$: giri$_3$, LB 1083: 4; YBC 05494: 15; YBC 06231: 15

Chronological organization of texts:

Group a	
YBC 05709	*Warad-Sîn* of Larsa year 09, month 6
YBC 07076	*Warad-Sîn* of Larsa year 09, month 6
AO 06353	*Warad-Sîn* of Larsa year 10, month 6
YBC 08759	*Rīm-Sîn* of Larsa year 06, month 11

(continued)

(continued)

Group a	
YBC 05494	*Rīm-Sîn* of Larsa year 06, month 03, day 29
YBC 04458	*Rīm-Sîn* of Larsa year 07, month 11
YBC 06231	*Rīm-Sîn* of Larsa year 08, month 03, day 13
AO 06371	*Rīm-Sîn* of Larsa year 09, month 04
Group b	
LB 2051	*Rīm-Sîn* of Larsa year 14, month 11
LB 2056	*Rīm-Sîn* of Larsa year 31, month 07, day 01
LB 1083	*Rīm-Sîn* of Larsa year 31, month 11$^{?}$, day 01
LB 1075	*Rīm-Sîn* of Larsa year 39, month 03, day 15
Uncertain group	
LB 2052	No date, reign of *Rīm-Sîn*$^{?}$
LB 2073	No date, reign of *Rīm-Sîn*$^{?}$
LB 1091	*Rīm-Sîn* of Larsa$^{?}$, month 04, day 26

Sîn-iddinam, spelled ^{d}nanna-ma-an-si$_3$, is the name of multiple scribes active in the reigns of *Warad-Sîn* and *Rīm-Sîn*. Thus, it is difficult to assess which *Sîn-iddinam* this may be. Here study is limited to giri$_3$ officials as well as officials who lack any other qualifier. Within these constraints, a *Sîn-iddinam* appears in two groups: in one group he appears active from the end of *Warad-Sîn*'s reign to the beginning of *Rīm-Sîn*'s reign (1826-1814 BCE), in the other he is active through the middle of *Rīm-Sîn*'s reign (1809-1784 BCE). While he appears in two texts studied here, only one of these texts is considered the work of this *Sîn-iddinam* or a scribe in his employ, LB 1075. Appearance of both *Diniktum* and Ešnunna as well as a year date in *Rīm-Sîn*'s reign suggest that this was produced somewhere in the northern part of the kingdom of Larsa or in Larsa itself and projecting merchant activity away from Larsa. This would be similar to activity described in the *Sîn-rāmā* archive below or *Ubār-Šamaš* archive above.

This scribe uses a tabular format to assess *bappiru* and salt, both measured in capacity. An additive and subtractive operation is carried out by this scribe as well as the sample remeasurement using a change rate, which was similar to revenue calculation in AO 08493 and which probably involved both multiplication and division via multiplication by the reciprocal of a number. Rounding by means of truncation is carried out in this calculation. Thus, the scribe memorized and trained with metrological tables of capacity and numerical tables (reciprocals and multiplication) in his elementary education. He also went on to an advanced education where he built on interest calculations to learn how to assess a value, perhaps a form of professional education.

2.CC *Sîn-rāmā*

—^{d}Sîn-*ra-ma*: AO 08468: 8 12, 16, 29; AO 08486: 2, 7, 22; AO 08512: 24; AO 08493: 5, 11, 15, 32, 35; AO 08512: 3; AO 08505: 6, 22, 24; AO 08522: 5; AO 08524: 2, 5

father of ^{d}Sîn-*i-ri-ba-am*: LB 1036: 25
ra$_2$-gaba-a-lugal: LB 1036: 18

Chronological organization of texts

LB 1036	*Warad-Sîn* of Larsa year 9, month 13
AO 08468	*Rīm-Sîn* of Larsa year 45, month 05, day 30
AO 08524	*Rīm-Sîn* of Larsa year 50, month 03, day xx
AO 08486	*Rīm-Sîn* of Larsa year 50, month 12, day 30
AO 08522	*Rīm-Sîn* of Larsa year 51, month 07, day 02
AO 08512	*Rīm-Sîn* of Larsa year 51, month 07, day 26
AO 08493	*Rīm-Sîn* of Larsa year 52?
AO 08505	*Rīm-Sîn* of Larsa?
AO 08492	*Rīm-Sîn* of Larsa?

Texts studied here from this archive center around a person named *Sîn-rāmā* and were probably the work of a conveyor working in his employ. One wonders if the *Sîn-rāmā* in these texts, dated between *Rīm-Sîn* of Larsa's 45th and 52nd year (1778-1771 BCE), is an elderly *Sîn-rāmā* who is listed as a royal messenger (ra$_2$-gaba-a-lugal) during *Warad-Sîn*'s ninth year (1826 BCE) in LB 1036. If so, this would explain *Sîn-rāmā*'s illness in lines 32, 33 of AO 08493 as well as the allocation of a royal tax to *Sîn-rāmā* in this same text. This very tentative suggestion would also mean *Sîn-rāmā* led an exceptionally long life. He is old enough to work as royal messenger at the end of *Warad-Sîn*'s reign and is still alive, albeit sick, 55 years later.

Connection between the texts studied here are made by means of similar personal names such as *Sîn-rāmā* and *Pištiya*, similar place names like aš-dub-ba^{ki}, similar vocabulary and spelling such as the use of the Akkadian words *na-am-ḫa-ar-ti,* as well as *mu-ši-im* and the use of the first person in Akkadian verb forms like *ak-nu-*[*ku*]*-ma*, 'which I sealed and' in AO 08524: 14, or *am-ḫu-ru*, 'that I accepted', in AO 08493: 6. This latter points to the nature of this archive: the personal nature of the texts and details surrounding it suggest this is a personal household archive rather than a state or temple administration.

In AO 08524 and AO 08493, four place names are mentioned. In AO 08524 Ašdubba and Isin are mentioned, while in AO 08493 Ašdubba, Larsa and Uruk are mentioned. Both texts list Ašdubba and AO 08493 states grain was collected in

Ašdubba at the e-sikilli and then transported to Larsa. Thus, *Sîn-rāmā* was probably based in Larsa and held a position in a temple, perhaps a liaison of some form between the temple and palace. This latter is especially suggested by the phrase 'the king calculated' in lines 3 through 4 of AO 08493, suggesting the income from a tax was allocated to *Sîn-rāmā*.

The scribe himself, whether *Sîn-rāmā, Pištiya* or more likely a conveyor working for *Sîn-rāmā*, works primarily with grain measured in capacity and performs additive and subtractive operations. In AO 08524 this leads to a form of rounding. Remeasurement of grain in AO 08493 shows an awareness of measurement inconsistency. In addition, revenue calculation, here a tax rate and then conversion rate in AO 08493 show the ability to multiply and then divide via multiplication by a number's reciprocal. The scribe exhibits awareness of several forms of error: measurement inconsistency when he remeasures grain, as well as potential error in calculation when he rounds a grain value up. The scribe is trained in metrological lists and tables of capacity as well as numerical tables of reciprocals and multiplication learned in the elementary phase of the scribal education and continued to learn how to calculate revenue in an advanced professional education similar to *Sîn-iddinam* above.

2.DD Scribe N

Chronological organization of texts:

AO 08461	*Rīm-Sîn* of Larsa year 57 or 58

The scribe who compiled AO 08461 (dated 1766 or 1765), a list describing grain disbursements, was probably active in or around Larsa based on the mention of *al*-Emaḫ in line 30. The author of this text is probably an official active on a local estate, whether this is a temple, palace or larger private estate. The author of AO 08461 works with grain evaluated by means of capacity measurement values and carries out an additive operation. In addition, a wage rate is provided in line 24 which shows an ability to divide via multiplication by a number's reciprocal. The rate is particularly interesting because it suggests the use of a rounded value and is evidence that the statement '*ša* u_4 X-kam', while incorporating an ordinal number, can act as a cardinal number to delimit time. Scribe N memorized metrological lists and tables for capacity as well as numerical multiplication tables in his elementary education and went on to an advanced, perhaps professional education where he learned how to calculate wage rates.

2.EE *Aḫūšunu*

—*a-ḫu-šu-nu*: LB 3051: 4, 23, 27

Chronological organization of texts:

LB 3051	*Rīm-Sîn* of Larsa year 59, month 10, day 28

There are multiple *Aḫūšunu*'s listed in the text collections and archives dated to the Old Babylonian period so that it is difficult to state exactly which *Aḫūšunu* wrote LB 3051 (dated 1764 BCE) or where he operated. This particular *Aḫūšunu*, or a scribe in his employ, works with capacity measurement values used to assess grain and weight measurement values to assess silver. He carries out an additive procedure in which two discrepancies appear. The first is probably an intentional example of rounding while the second is certainly a mistake that may point to the use of a counting devise such as an abacus. He rounds down, however, to produce a truncated value. The author of NBC 06339 memorized metrological lists of capacity and weight in his elementary education.

2.FF Scribe O—Grain Production Archive

Chronological organization of texts:

Ashm 1923-311	*Hammu-rābi* of Babylon year 32, month 03, day 16

The unnamed author of Ashm 1923-311, active in a grain production archive dated to *Ḫammu-rābi*'s 32nd year (1761 BCE) after his conquest of Larsa, surveys and then projects yields associated with a series of fields followed by oxen that are allocated to these fields for grain production. Exact location is uncertain, although line 37 states 'bank of the *Uggimdu* other side of the place *Šamaš-Ea*'. This scribe acts as a field inspector, similar to scribe P, whose duties were to survey land in preparation for planting, as well as to project yields.

Scribe O describes agricultural works in capacity measurement values to quantify grain, in system S to quantify oxen and in area to quantify land. He carries out a series of additions and then rounds the total down from 2/3 *sila* to 1/2 *sila*. Scribe O thus memorized metrological lists of capacity and area. Because he projects yields, he was probably versed in metrological tables of capacity, length and area, as well as numerical tables of multiplication and held an advanced, perhaps professional education devoted to field surveying, similar to Scribe P and perhaps Scribe T.

2.GG Scribe P—Grain Production Archive

Chronological organization of texts:

Ashm 1922-277	*Hammu-rābi* of Babylon year 35, month 3, day 20
Ashm 1923-340	*Hammu-rābi* of Babylon year 35, month 3, day 22

Scribe P is also active in what may be called a grain production archive. Scribe P employs tabular format to assess land while scribe O uses a prosaic format to organize data. This suggests either an administrative shift between the time of scribe O's activity and scribe P's activity, a different administration all together, or a different target audience. However, content is similar between these two scribes, especially between Ashm 1923-311 of scribe O and Ashm 1922-277 of scribe P. The scribe at work in this archive is also active during the reign of *Hammu-rābi* (1758 BCE). He surveys land and then projects the yields for various fields of the temple of Nanna at Ur. Although these texts refer to land around Ur, this administration may have been carried out or even simply recorded at Larsa itself. The author of these texts, as well as Scribe O, surveys fields and predicts yields so that two more texts can be suggested that would make a complete archive if they existed: costs in harvesting and maintenance and then actual yields. Harvest texts from the reign of *Rīm-Sîn* are witnessed in the grain harvest archive.

The author of this archive works in area measurement values and then capacity measurement values to carry out his assessments and predictions. He carries out additive operations in both text while in Ashm 1923-340 standard yield rates are visible, which suggests an ability to multiply and divide via multiplication by a number's reciprocal. As suggested in this text's discussion, the yield rates themselves suggest the author is multiplying with SPVN and not measurement values because each stated rate is based on 2 *bur*, which corresponds to SPVN 1, not 1 *bur*. The arrangement of the measurement values themselves and an example of rounding suggest how measurement values were understood and used in addition, offering evidence for a calculation tool, perhaps an abacus (see Chap. 6 for this).

The scribe was familiar with metrological lists of capacity length and area, as well as corresponding metrological tables and numerical multiplication tables, all memorized in the elementary phase of scribal education. An advanced education is also evident, consisting of studies in yield calculations and area calculations. Scribes in this archive probably partook in a form of professional education devoted to field surveying that occured outside of the typical scribal curriculum.

2.HH *Nabi-Šamaš* B

—*na-bi-*[d]Šamaš: LB 1837: 24; Riftin 1937: no. 033: 12; YBC 04265: 9; YBC 06306: 1

son of [d]Sîn-*i-qi-ša-am*: Riftin 1937: no. 017

Chronological organization of texts

LB 1837	*Rīm-Sîn* of Larsa year 23, month 11
YBC 06306	*Rīm-Sîn* of Larsa year 24, month 09
(Erm—) Riftin 1937: no. 017	*Rīm-Sîn* of Larsa year 34, month 08
YBC 04265	*Hammu-rābi* of Babylon year 36, month 04, day 04
(Erm—) Riftin 1937: no. 033	*Samsu-iluna* of Babylon year 11, month 12, day 01

A *Nabi-Šamaš* is active in three clusters of texts: around *Rīm-Sîn* of Larsa's first regnal year (1822 BCE), the middle of *Rīm-Sîn*'s reign (1800-1789 BCE) and after the conquest of Larsa by *Hammu-rābi* of Babylon (1757 and 1739 BCE). The first is certainly not the same as the latter two. He is described as the son of *Adayatum* in Ashm 1922-300 line 10, while Riftin 1937: no. 017 describes him as the son of *Sîn-iqīšam*. *Nabi-Šamaš*, son of *Sîn-iqīšam*, active in *Rīm-Sîn* of Larsa's 34th year (1789 BCE), could plausibly be connected to the later *Nabi-Šamaš* who is active here if he had a very long career. According to Stol (1982: 131), provenance of YBC 04265 here as well as other texts studied by him is generally speaking Larsa. *Nabi-Šamaš* is probably a merchant acting as a member of the local *kārum* on behalf of the crown to assess excess capital or grain in silver or labor. In YBC 04265, *Nabi-Šamaš*, a merchant, is shown to ship grain in a similar capacity as is witnessed with the grain storage bureau that was active in the reigns *Warad-Sîn* and *Rīm-Sîn*.

YBC 04265 is either the work of this *Nabi-Šamaš* or a scribe in his employ. Here he works in grain measured by capacity and is probably converting grain from one standard to another by means of a sample measurement and change rate. Thus, he has memorized metrological lists and tables for capacity as well as numerical tables of reciprocals and multiplication in the elementary phase of scribal education. An advanced, perhaps professional education is also evident consisting of exercises with conversions between capacity standards.

2.II Scribe Q—Bureau of Irrigation and Excavation

—*na-mi-ra-am-ša-ru-*[*ur*]: YBC 12273: 11

Chronological organization of texts:

YBC 12273	*Hammu-rābi* of Babylon year 38, month 03, day 25

The author of YBC 12273, listed as scribe Q, is the latest actor discussed here from the bureau of irrigation and excavation, operating under *Hammu-rābi* of Babylon in his 38th year (1755 BCE) after he conquered the kingdom of Larsa. The activities described in YBC 12273 center around *Namīram-šarur*, a canal contractor of unknown provenance.[9] While the location of *Namīram-šarur*'s activities in YBC 12273 are broken, the scribe who wrote this text is possibly part of the bureaucracy located in Larsa, active in this bureau and thus, educated within the city of Larsa itself.

In YBC 12273, the author describes at least four canal lengths and volumes to be excavated by multiplying length by width by depth. Interestingly, he appears to present lengths, widths and heights using a form of SPVN. However, YBC 12273 focusses on estimating man-days labor out of these estimated volumes. Indeed, because these numbers are expressed in SPVN, they were probably only used to show how values in volume was obtained because volumes, work assignments and man-days labor are quantified using the systems for volume and discrete numbers. Man-days labor is estimated by multiplying volume and the reciprocal of the work assignment. However, the appearance of SPVN in this text does show that SPVN was used in multiplication, especially in YBC 12273 but probably throughout the life of the bureau of irrigation and excavation.

The author of YBC 12273 is probably learned in metrological tables of capacity, length, height and volume as well as numerical tables of reciprocals and multiplication learned in the early phase of scribal education, as well as an advanced education involving volume and labor calculations which suggests familiarity with labor coefficients. Part of his education probably took place in a professional environment as was also suggested for *Lu-igisa*, scribe I, and *Immer-ilī* above, scribe R below, as well as to a limited degree *Nabi-Šamaš* A. This is further evident with thetabular format of this text. Thus, the author partakes of an elementary education in which metrological and numerical tables were memorized, as well as an advanced, partially professional education.

[9]Perhaps *Namīram-šarur* is the same person as or a relative of *Namram-šarur*, brother of *Lamassatum* in HS 2197: 7 (dated Rīm-Sîn year 45, month 10) and father of *Suḫḫuntum* in HS 2246 (dated to *Samsu-iluna* year 13, month 11 day 20). If so, then he would have been located in Nippur.

2.JJ *Zinnu*

—*zi-nu-u*$_2$: Ashm 1922-279: 11, 18; Ashm 1922-306: 2; Ashm 1922-330: 4; Ashm 1922-338: 4; Ashm 1923-058, tablet: 5, case: 4; Ashm 1923-298: 6

Chronological organization of texts:

Group a	
Ashm 1922-306	*Rīm-Sîn* of Larsa year 01, month 11, day 20
Group b	
Ashm 1923-058 tablet	*Hammu-rābi* of Babylon year 38a, month 01, day 01
Ashm 1923-058 case	*Hammu-rābi* of Babylon year 39, month 01, day 01
Ashm 1922-279	*Hammu-rābi* of Babylon year 39a
Ashm 1922-330	*Hammu-rābi* of Babylon year 39a, month 09, day –
Ashm 1923-298	*Hammu-rābi* of Babylon year 39a, month 09
Ashm 1922-338	*Hammu-rābi* of Babylon year 42, month 04, day 04

There are probably at least two different *Zinnu*'s active in the kingdom of Larsa, one operating at the very beginning of *Rīm-Sîn*'s reign (1822 BCE) and then one active between *Hammu-rābi*'s 38th and 42nd year (1755-1751 BCE). The exact location of this scribe's activity is uncertain. *Zinnu* or the scribe in his employ works assessing sesame produced in three different places by capacity measure. An additive operation is carried out in which a mistake is made in carrying numbers between columns, for which see Appendix 5. This mistake bespeaks of a counting device, for which see Chap. 6. *Zinnu* thus memorized metrological lists in his elementary phase of education where he probably learned to calculate using a counting device.

2.KK *Šēp-Sîn* B

—*še*$_{20}$*-ep-*^{d}Sîn: s. of^{d}Šamaš-*mu-ba-li*$_2$*-iṭ*, dam-gar$_3$ larsa^{ki}: HE 111: 23

ugula dam-gar: A.26371: 4

Chronological organization of texts:

A.26371	*Hammu-rābi* of Babylon year 40, month 05
HE 111	*Samsu-iluna* of Babylon year 05, month 03, day 30

For a discussion of *Šēp-Sîn* see Tyborowski (2003) where two persons are identified by this name, one operating at the end of *Rīm-Sîn*'s reign and *Hammu-rābi*'s rule of Larsa (*ibid.*: 71–72), while the second was active for several decades at the end of *Rīm-Sîn*'s reign (*ibid.*: 73). As Tyborowski notes, in several texts these two appear simultaneously allowing for little doubt that there were two separate individuals named *Šēp-Sîn* operating at the same time in Larsa. As discussed above, a third separate *Šēp-Sîn* appeared in a text dated to *Rīm-Sîn*'s 20th year in office. The dates of A.26371 and HE 111, *Hammu-rābi* year forty (1753 BCE) and Samsu-iluna year five (1745 BCE) respectively, suggest both of these tablets belong to the former of Tyborowski's *Šēp-Sîn*, the product of his hand or of a scribe in his employ. *Šēp-Sîn*, described as merchant overseer, is probably a merchant acting as a member of the local *kārum* on behalf of the crown to assess excess capital or grain in silver or labor.

The author of these two texts measures various items by capacity as well as silver and wool measured by weight. An additive process is carried out in HE 111 in both silver and in capacity. In HE 111 equivalency rates, described as ganba, are also evident, showing familiarity with multiplication and with division via multiplication by a number's reciprocal. Further, allusion is made to an interest calculation present in A.26371 suggesting a similar multiplication by a number's reciprocal. Finally, with A.26371 line 3 a standard is specified which suggests the scribe is familiar with standard conversions.

Thus *Šēp-Sîn* is experienced with various metrological lists and tables, including lists and tables of capacity and weight, as well as numerical tables of reciprocals and multiplication memorized in the elementary phase of scribal education. He also understands revenue calculations, standard conversions and equivalencies, all probably learned in an advanced, perhaps professional phase of scribal education.

2.LL *Sîn-muštāl*

—^{d}Sîn-*mu-uš-ta-al*: YBC 04264: 4; VAT 08408: 5
son of ^{d}Sîn-*ma-gir*: YBC 06746: seal; YBC 05397: seal
ugula-dam-gar$_3$ uri$_2^{ki}$, YBC 07744: 15

Chronological organization of texts:

YBC 04264	*Hammu-rābi* of Babylon year 40, month 11, day 28
YBC 07744	*Hammu-rābi* of Babylon year 41, month 02, day 20
VAT 08408	*Samsu-iluna* of Babylon year 01, month 01, day xx

(continued)

(continued)

YBC 06746	*Samsu-iluna* of Babylon year 04, month 07, day 14
YBC 05397	*Samsu-iluna* of Babylon year 06, month 02, day 08

The author of YBC 07744 is probably *Sîn-muštāl*, merchant overseer of Ur towards the end of *Hammu-rābi*'s reign and the beginning of *Samsu-iluna*'s reign (1753-1744 BCE), or a scribe in his employ. As merchant overseer, *Sîn-muštāl* would have been responsible for assessing excess crown capital in silver by means of merchant intermediaries in the local *kārum* or merchant community of Ur. In YBC 07744 calculation is carried out using weight and silver measurement values as well as system S. Basic addition is carried out as well as equivalencies of fish assessed by weight into counted quantities expressed in system S, and then from these counted quantities into a weight in silver value. Additional equivalencies are made from counted quantities as well as capacity into silver weight. The scribe thus memorized metrological tables for capacity and weight, as well as numerical tables of reciprocals and multiplication in his elementary education and went on to learn how to make equivalencies in an advanced education of some form.

2.MM *Abu-waqar*

—*a-bu-wa-qar*: nam-5, YBC 04470: 17

Chronological organization of texts:

YBC 04470	*Hammu-rābi* of Babylon year 41, month 04, day 04+

For a discussion of this notable see Feuerherm (2004). Whether the same *Abu-waqar* as studied by Feuerherm or not, he is described here as an overseer of a group of five in *Hammu-rābi*'s forty-first year in power (1752 BCE). This *Abu-waqar* is probably a merchant acting as a member of the local *kārum* on behalf of the crown to assess excess capital or grain in silver or labor. *Abu-waqar*, acting as a merchant, is seen in YBC 04470 shipping grain in a similar capacity as is witnessed with the grain storage bureau that was active in the reigns of *Warad-Sîn* and *Rīm-Sîn*.

In YBC 04470 *Abu-waqar* works primarily in capacity measurement values used to evaluate grain and performs an additive process in which several discrepancies are evident that seem to be the results of simple epigraphic mistakes—wedges are omitted which were clearly intended. In addition, several standards are mentioned to evaluate these quantities which points to an understanding of standard conversions. He probably memorized metrological and numeric tables in his elementary

phase of scribal education and learned about standard conversions in his advanced, perhaps professional scribal education.

2.NN *Ilīma-abī*

—*i_3-li_2-ma-a-bi*: A.26378: 4, 9, 15

Chronological organization of texts:

Group a	
AO 06379	*Warad-Sîn* of Larsa year 08, month 95
YBC 04376	*Rīm-Sîn* of Larsa year 01, month 12
Group b	
YBC 05733	*Rīm-Sîn* of Larsa year 16, month 12
YBC 06745	*Rīm-Sîn* of Larsa year 16, month 12
YBC 08747	*Rīm-Sîn* of Larsa year 16, month 12, day 06
Group c	
YBC 05676	*Rīm-Sîn* of Larsa year 20, month 06
YBC 05680	*Rīm-Sîn* of Larsa year 21, month 03
Group d	
YBC 04201	*Rīm-Sîn* of Larsa year 33, month 07
YBC 04335	*Rīm-Sîn* of Larsa year 33, month 10, day 20
Group e	
Ashm 1923-374	*Hammu-rābi* of Babylon year 32 or 38, month xx day 30
(Erm—) Riftin 1937: no. 001	*Hammu-rābi* of Babylon year 35
Ashm 1923-340	*Hammu-rābi* of Babylon year 35, month 03, day 22
A.26378	*Hammu-rābi* of Babylon year 41, month 04, day 24

It's clear from the various archives that at least three if not five *Ilīma-abī*'s exist in the texts: the first appears in two texts dated between king *Warad-Sîn*'s eighth regnal year and *Rīm-Sîn*'s first year (1827 and 1822 BCE), the second appears clustered around *Rīm-Sîn*'s 16th year (1807 BCE), a third in year 20 and 21 (1803-1802 BCE), possibly a fourth in *Rīm-Sîn*'s 33rd year in power (1790 BCE), and a fifth represented by four texts including Ashm 1923-340 and A.26378 here is active during *Hammu-rābi*'s rule of Larsa (1761-1752 BCE). Mentioned in Ashm 1923-340, he is thus possibly active in the city of Ur. He is also possibly a merchant acting as a member of the local *kārum* on behalf of the crown to assess excess capital or grain in silver or labor and may have been based in the city of Larsa for this reason. In A.26378, *Ilīma-abī* is seen shipping grain in a similar capacity as is witnessed with the grain storage bureau that was active in the reigns of *Warad-Sîn* and *Rīm-Sîn*.

The author of A.26378 works with multiple standards in evaluating grain transactions between Babylon and the former realms of Larsa. He thus memorized metrological and numeric tables in his elementary education and probably went on to learn about conversions between standards in his advanced, perhaps professional education.

2.OO *Iddin-Ištar*

—*i-din*-iš_8-tar_2, s. of *a-ḫu-wa-qar*: YBC 07787: 5, seal: 1

Chronological organization of texts:

YBC 07787	*Hammu-rābi* of Babylon year 43, month 11, day 30

There are at least three *Iddin-Ištar*s in the textual record. However, YBC 07787 (dated 1750 BCE) is the only text attested for a son of *Aḫu-waqar*, as first pointed out by Stol (1982: 184). As Stol suggests provenance is possibly Larsa itself (*ibid.*: 131). *Iddin-Ištar* is probably a merchant acting as a member of the local *kārum* on behalf of the crown to assess excess capital or grain in silver or labor.

The author of YBC 07787 works with silver evaluated by weight. Division into thirds suggests familiarity with multiplication by a number's reciprocal. He is able to assess proportions of value and must have been able to make equivalencies between products, although initial in-kind values and rates are not stated. A subtractive process is also suggested in this text. This author thus memorized metrological tables of weight as well as numerical tables of reciprocals and multiplication in his elementary education and learned how to divide property and make equivalencies which may have made up his advanced, perhaps professional education.

2.PP *Aḫiya*

—$^{\text{I}}$*a-ḫi-ia*: ugula-nam 5, AUAM 73.2672: 5

Chronological organization of texts:

AUAM 73.2672	*Samsu-iluna* of Babylon year 07, month 06, day 22

Although several *Aḫiya*'s are mentioned in the texts, AUAM 73.2672, dated 1743 BCE, is the only one mentioning him as an overseer of five. He is probably a merchant acting as a member of the local *kārum* on behalf of the crown to assess excess capital or grain in silver or labor. In AUAM 73.2672 *Aḫiya* assesses dates by means of capacity measurement value and silver by means of weight. Equivalency

is made between capacity and weight suggesting an ability to divide via multiplication by a number's reciprocal. However, this could also be a simple cutting of a number in half. In any event, the author of this text probably memorized metrological lists of capacity and weight in his elementary education, perhaps even tables of capacity and weight as well as numerical tables of reciprocals and multiplication and then went on to study equivalencies in his advanced, perhaps professional education.

2.QQ *Issu-nar-…*

—*is-su-na-ar*-x: Ashm 1923-315: 23

Chronological organization of texts:

Ashm 1923-315	Date uncertain

The personal name *Issu-nar*-[…] only appears in one text studied here, Ashm 1923-315 of uncertain provenance and date, where he is perhaps the author acting as a household administrator. In this text he is the recipient and only personal name mentioned. Because *Issu-nar*-[…] is the recipient, it seems unlikely that he would leave the accounting to another, unnamed individual, so that mathematical procedures found in this text are here attributed to him.

There are several procedures carried out in Ashm 1923-315: a simple addition of capacity measurement values terminating with šu-nigin, total, in line 22. In addition, a wage calculation is carried out: 5 days labor is probably multiplied by a rate of 1 *bariga* 3 *ban* grain per day to produce 1 *gur* 2 *bariga* 3 *ban* stated in the text. An equivalency was also produced which assessed silver, valued at 5 *gin* by a grain equivalent of 4 *gur* 4 *ban* because grain was the medium of evaluation in the text. No rate is stated. However, 5 *gin* was probably multiplied by 4 *bariga* 8 *sila* to produce 4 *gur* 4 *ban*. Calculation was probably in SPVN, although this is not stated.

Issu-nar-[…] is adding values based on metrological lists and tables he learned in the elementary stage of education, this is clear from the added values in the text which are composed of values found on these lists and tables. Numerical tables learned in this elementary education were probably used to carry out multiplication. In addition, he must have learned how to produce equivalencies and calculate wage rates in an advanced, perhaps professional education.

2.RR Scribe R—Bureau of Irrigation and Excavation

Chronological organization of texts:

Ashm 1922-290	Date broken

The author of Ashm 1922-290 mentioned in Chaps. 8 and 9 is probably active in the bureau of irrigation and excavation. In Ashm 1922-290 there is a difference between many expected and extant volumes suggesting that the author of this text carried out an assessment similar to the author of NBC 06763. He would then be acting as a canal inspector as well. However, Ashm 1922-290 is much larger and may perhaps be a survey of all planned or current activity. This would then be a report produced by the bureau head or a scribe working for him. Either way, he would have been based in Larsa.

The author of Ashm 1922-290 works with length and height measurement values as well as volume measurement values. He carries out a basic additive operation that involved rounding by means of truncation. He thus memorized metrological lists in his elementary education. In addition, he probably used labor coefficients in a similar manner as NBC 06763 to assess volume which speaks of division by means of multiplication of these coefficient's reciprocal. The author is familiar with both reciprocal tables and coefficient lists, at least where labor and volume is concerned. He is also willing to round values. Thus, this scribe probably took part in an advanced education consisting of memorization of coefficients and calculation of excavated volumes as well as labor and perhaps wages. The scribe who wrote this text may have received a similar advanced, partially professional education to that also suggested for *Lu-igisa*, scribe I, *Immer-ilī*, and scribe Q.

2.SS Scribe S

Chronological organization of texts:

Ashm 1924-453	No date

The unnamed author of Ashm 1924-453 acts as a member of a household of unstated size recording grain rations to various individuals within the household over two consecutive days. He seems to act then as a simple clerk assessing daily costs. Totals are not provided in Ashm 1924-453. Instead, SPVN transformations of the expected totals are stated in this text. The use of SPVN in place of the expected totals suggests intent to perform a later multiplication (see Chap. 5 for this). Dating is only made to the day of the month, while the month itself and year are omitted, so that this text was probably only meant as a temporary document that would become redundant once the suggested calculation was completed. It is only meant to justify the calculation for the archive owner and then would be destroyed. In any event, the author probably memorized metrological lists and tables of capacity in his elementary scribal education, as well as perhaps numerical tables of multiplication.

2.TT Scribe T

Chronological organization of texts:

LB 1097	No date

The unnamed author of LB 1097 is active as a fieldinspector in an additional agricultural production archive, perhaps based near the city of Umma. The author states grain to be expended in preparing a field for excavation. He is estimating future costs, not current costs, as suggested by this text's lack of any date formula and use of partial-SPVN for capacity measurement values. This partial-SPVN might point to a kind of counting device used in producing the total, or this partial-SPVN may point to a later added calculation (see Sect. 5.3 for these possibilities).

Scribe T carries out assessments of grain to be expended in several different steps of field preparation, approximating grain per land rates. This author was probably learned in metrological tables of capacity, area and probably length as well, all of which were learned in the elementary phase of his scribal education. He is also likely familiar with numerical tables of reciprocals and multiplication learned in this same phase and went on to an advanced, perhaps professional education devoted to field surveying, where he learned to manipulate area measurement values and assess costs in field preparation. This, advanced education might have been similar to those suggested for the grain production archive.

2.UU Conclusions

This appendix asked 'what do the texts tell us about each scribe?' in order to examine whether each scribe carried out mathematical processes while compiling the texts studied here. First, as stated in Chap. 4, the bureaus tended to enforce standard practices which expressed a certain tacit knowledge attained outside of the extant scribal education. These standard practices are especially seen here, where scribes exhibited specialized knowledge that may have been the result of a professional education such as those hypothesized in Chap. 4. Thus, specialized knowledge and practice was suggested with *Lu-igisa*, scribe I, *Immer-ilī*, scribe Q and with scribe R, which leads to the conclusion that some professional education existed outside of the scribal curriculum. This professional education is posited as the reason for producing texts like BM 085211 and BM 085238, both of the bureau of irrigation and excavation. Indeed, a professional education, that is an education outside of a standard or traditional scribal school environment, was posited for the majority of scribes who could be shown to have received some form of advanced education. This is suggested with, for instance, change rate calculations for *Sîn-iddinam* and tax revenue calculations for *Sîn-rāmā*. This was also suggested for

many of the equivalency calculations with *Itti-Sîn-milki* and wage calculations with *Issu-nar*-[…].

In addition, it can be said from the study here that each of these scribes exhibit some mathematical knowledge and many exhibited knowledge that was probably not expressed in the traditional scribal education. Instead this may be evidence for apprenticeships or other professional educations beyond or outside of a traditional advanced education. This supports the assertions of Veldhuis (2011) and Michalowski (2012) that there may have been a large portion of scribes who received some or all of their advanced education outside of the scribal school and in a professional setting. Finally, it must be noted that even the least complex text offered evidence for an elementary education that incorporated metrological lists used in basic addition and subtraction. Thus, a general elementary scribal education probably existed throughout the kingdom of Larsa, regardless of setting, one that incorporated at a minimum metrological lists and probably metrological and numerical tables as well.

Appendix 3
Metrological and Numerical List and Table Catalogue

Appendix 3 catalogues metrological lists and tables as well as numerical lists and tables used to construct tables in Chap. 2.

3.A Metrological Texts

The metrological texts from Nippur are well studied by Proust (2007 and 2008). Evidence from Larsa is presented in Robson (2004b). Metrological texts from Ur are found in Friberg (2000). Note that texts from Larsa especially, as pointed out in Chap. 1, were often purchased on the antiquities market, the result of an illicit dig in the late nineteenth and early twentieth century. Provenance therefore is not certain. Thus, with caution texts for which the origin is suggested as Larsa appear in this study while this caution is emphasized with a question mark (?) following provenance. Below, each table lists museum number or publication number first, that is, where the document itself is located, then publication, that is where it appears in copy or translation, provenance and finally a description of the text. Division is by capacity, weight, area, length and then height.

R. Middeke-Conlin, *The Making of a Scribe*, Why the Sciences of the Ancient World Matter 4, https://doi.org/10.1007/978-3-030-35951-5

3.A.a Capacity

Museum or publication number	Publication	Provenance	Description
Uncertain	Hilprecht 1906: no. 36, pl 23	Nippur	Type III, table, broken, 1 gin$_2$ še ku$_3$-babbar to 9 sila$_3$, 1(gur) 4(bariga) gur to 2(geš$_2$) gur
Ashm 1932-526n	Robson 2004b: 23, 24	Larsa?	Type III, standard list, broken, 1/3 sila$_3$ to 1 5/6 sila$_3$
Ashm 1933-180	Robson 2004b: 24	Larsa?	Type II?, standard list, broken, 8 sila$_3$ to 2 (ban$_2$)
CBS 19820	Hilprecht 1906: no. 34, pl 22	Nippur	Type II, table, worn, 2 gin$_2$ to 13 gin$_2$, 1 1/3 sila$_3$ to 9 sila$_3$
HS 234	Proust 2008: 37, pl 16	Nippur	Type I, table, broken, 1(ban$_2$) to 3 (bariga) 2(ban$_2$) še, 17 gur to 9(geš$_2$) gur, 1(šar'u) 1(šar$_2$) gur to šar$_2$×20 gur
HS 236	Proust 2008: 28, pl 6	Nippur	Type II, 4(bariga) 4(ban$_2$) še to 6 gur, 50 gur to 9(geš$_2$) gur
HS 238+1667	Proust 2008: 33, pl 12	Nippur	Type II, list, broken, 9 gin$_2$ to 18 gin$_2$, 5 sila$_3$ to 1(ban$_2$) 6 sila$_3$, 2(bariga) 1 (ban$_2$) še to 3(bariga) 4(ban$_2$) še, 4 gur to 10 gur
HS 239 + 250 + 256	Proust 2008: 27, pl 5; Hilprecht 1906: no. 37, pl 24	Nippur	Type II, list, broken, 1 gin$_2$ to 17 gin$_2$, 19 gin$_2$ to 8 sila$_3$, 1(ban$_2$) 4 sila$_3$ + 2 (bariga) še, 3(bariga) še to 1(gur) 4 (bariga) gur
HS 249 + 1805	Proust 2008: 23–25, pl 2, 3	Nippur	Type I, standard + height?, complete list, broken
HS 252	Proust 2008: 40, pl 18	Nippur	Type II, table, broken, 3 sila$_3$ to 7 sila$_3$
HS 257 + 275	Proust 2008: 24, 25, pl 4	Nippur	Type I, list, broken, 3 gin$_2$-13 gin$_2$, 1 (ban$_2$) 3 sila$_3$ to 1(ban$_2$) 9 sila$_3$, 10 to 12 sar
HS 260	Proust 2008: 39, pl 17	Nippur	Type II, table, broken, 4(bariga) 3 (ban$_2$) še to 7 gur, 18 gur to 1(geš$_2$) 30 gur
HS 261	Proust 2008: 35, pl 14	Nippur	Type II, list, broken, 1 1/3 gin$_2$ to 1/3 sila$_3$, 2/3 sila$_3$ 1(ban$_2$) 7 sila$_3$
HS 264	Proust 2008: 32, pl 11	Nippur	Type II, list, broken, 2 gin-$_2$ to 19 gin$_2$, 2/3 sila$_3$ 1(ban$_2$) še, 1(ban$_2$) 5 sila$_3$ to 1(bariga) 4(ban$_2$) še, 2(bariga) 5(ban$_2$) še to 4(bariga) 5(ban$_2$) še
HS 271a	Proust 2008: 36, pl 15	Nippur	Type uncertain, list, broken, 8 gin$_2$ to 1 sila$_3$

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Museum or publication number	Publication	Provenance	Description
HS 1645	Proust 2008: 39, pl 17	Nippur	Type II, 1(ban$_2$) 1(sila$_3$) to 1(ban$_2$) 4 sila$_3$
HS 1703	Proust 2008: 29, pl 7	Nippur	Type II, list, broken, 1 1/2 gin$_2$ to 19 gin$_2$, 2 sila$_3$ to 1(bariga) 5(ban$_2$) še, 2 (bariga) 3(ban$_2$) še to 10 gur, 14 gur to 1(geš'u) 4(geš$_2$) gur, 1(geš'u) 8 (geš$_2$) gur to 4(šar'u) gur
HS 1718	Proust 2008: 30, pl 9	Nippur	Type II, list, broken, 7(šar$_2$) gur to 9 (šar$_2$) gur, 25 še to 29 še
HS 1729	Proust 2008: 34, pl 13	Nippur	Type II, list, broken, 1(geš$_2$) gur to 1 (geš'u) 3(geš$_2$) gur, 3(šar$_2$) gur to 2 (šar'u) gur
HS 1836	Proust 2008: 38, pl 16	Nippur	Type II, table, broken, 3(bariga) 2 (ban$_2$) še to 1(gur) 2(bariga) gur, 14 gur to 17 gur, 20 gur to 1(geš$_2$) 20 gur
HS 1848	Proust 2008: 26, pl 4	Nippur	Type II, list, broken, 2(bariga) gur to 3(bariga) gur, 1(gur) 4(bariga) gur to 3 gur
HS 2638	Proust 2008: 40, pl 18	Nippur	Type II, table, broken, 1 gin$_2$ še to 1 5/6 gin$_2$
NI 763	Proust 2007: pl 1	Nippur	Type IV, list, 1(bariga) 3(ban$_2$) to 1 (bariga) 5(ban$_2$)
NI 1878	Proust 2007: pl II	Nippur	Type II, broken table, 1 gin$_2$ to 19 gin$_2$, 2(ban$_2$) to 3(bariga) 1(ban$_2$)
NI 2247	Proust 2007: pl III	Nippur	Type I, broken list, 1 1/3 gin$_2$ to 7 gin$_2$, broken sila$_3$
NI 2357	Proust 2007: pl III	Nippur	Type II, broken 1(šar$_2$) 4(gešu) gur to 1(šar$_2$) 5(gešu) gur
NI 2782	Proust 2007: pl VII	Nippur	Type IV, list, 1/3 sila$_3$ to 1 sila$_3$
NI 3242	Proust 2007: 331, pl X	Nippur	Type II, list, broken, 1 1/3 sila$_3$ to 6 sila$_3$
NI 3308	Proust 2007: 331, pl XI	Nippur	Type II, list, broken, 3(ban$_2$) to 2 (bariga) 3(ban$_2$)
NI 3367	Proust 2007: 333, pl XII	Nippur	Type II, list broken, 1/2 sila$_3$ to 1 5/6 sila$_3$, 1(bariga) 2(ban$_2$) to 2(bariga) 2 (ban$_2$), 8 gur to 12 gur
NI 3515	Proust 2007: pl XII	Nippur	Type II, list, broken, 1(gešu) 5(geš$_2$) gur to 1(šar$_2$) 1(gešu) gur
NI 3633	Proust 2007: 335, pl XIV	Nippur	Type II, list, broken, 2 sila$_3$ to 5 sila$_3$
NI 3634	Proust 2007: 336, pl XIV	Nippur	Type II, list, broken, 1(bariga) to 1 (bariga) 4(ban$_2$), 4(bariga) 4(ban$_2$) to 1 gur 4(bariga)

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Museum or publication number	Publication	Provenance	Description
NI 3678 + 3783	Proust 2007: 336, pl XV	Nippur	Type II, list, broken, 1(ban$_2$) 8 sila$_3$ to 1(bariga) 5(ban$_2$) še, 3(bariga) 1 (ban$_2$) to 4 (bariga) 5 (ban$_2$) še
NI 3705	Proust 2007: 336, pl XVI	Nippur	Type II, list or table, broken, 4(ban$_2$) to 1(bariga) 1(ban$_2$)
NI 3711	Proust 2007: 337, pl XVII	Nippur	Type II, list broken, 7 gur to 20 gur, 6 (geš$_2$) gur to 1(geš'u) 6(geš$_2$) gur
NI 3741	Proust 2007: 338, pl XVII	Nippur	Type II, list broken, 2(bariga) 1(ban$_2$) to 4(bariga) 3(ban$_2$), 8 gur to 20 gur
NI 3742	Proust 2007: pl XVIII	Nippur	Type II, list, broken, 1(geš$_2$) 30 gur to 5(geš$_2$ gur
NI 3746	Proust 2007: pl XVIII	Nippur	Type II, table, broken, 4 sila$_3$ to 6 sila$_3$
NI 3759	Proust 2007: 338, pl XVIII	Nippur	Type II, table, broken, 1/3 sila$_3$ to 3 sila$_3$, 3(ban$_2$) še to 1(bariga) 5(ban$_2$) še, 7 gur to 18 gur, 7(geš$_2$) gur to 1 (geš'u) 3(geš$_2$) gur
NI 3815	Proust 2007: 339, pl XIX	Nippur	Type II, list broken, 7 gur-19 gur, 5 (geš'u) gur to 1(šar$_2$) 5(geš'u) gur
NI 3896	Proust 2007: pl XX	Nippur	Type II, list, broken, 1(ban$_2$) to 1 (ban$_2$) 3 sila$_3$
NI 3913	Proust 2007: 340, pl XXI	Nippur	Type II, list, broken, 4 sila$_3$ to 1(ban$_2$) 4 sila$_3$, 1(bariga) to 3 (bariga) 5(ban$_2$), 4(bariga 5(ban$_2$) to 13 gur
NI 4744	Proust 2007: 341, pl XXI	Nippur	Type II, table, broken, 1(geš$_2$) gur to 2(geš$_2$) gur
NI 4813	Proust 2007: 343	Nippur	Type II, list, damaged, 4(ban$_2$) še to 1 (bariga) 5(ban$_2$) še
NI 4840 + UM 29-13-711	Proust 2007: 343	Nippur	Type II, list, damaged, 3 gin$_2$ to 11 gin$_2$, 15 gin$_2$ to 9 sila$_3$, 1(ban$_2$) 2 sila$_3$ to 1(bariga) 1(ban$_2$), 1(bariga) 4(ban$_2$) to 2 gur, 5 gur to 17 gur, 1(geš$_2$) gur to 9(geš$_2$) gur, 1(šar$_2$) gur to 7(šar$_2$) gur, 1(šargal)$^{\text{gal-la}}$ gur,
NI 4908	Proust 2007: pl XXVII	Nippur	Prism, table, fragment, 1(ban$_2$) 8 sila$_3$ to 4(ban$_2$)
NI 5168	Proust 2007: 345, pl XXX	Nippur	Type II, table, broken, 1 gur 4(bariga) to 6 gur, 1(geš$_2$) 30 gur to 1(geš$_2$) 50 gur
NI 5196	Proust 2007: pl XXXIII	Nippur	Type II, list, broken, 2/3 sila$_3$ to 1 2/3 sila$_3$

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Museum or publication number	Publication	Provenance	Description
NI 5206	Proust 2007: 345, pl XXXIV	Nippur	Type II, list, broken, 1 1/2 gin_2 to 9 gin_2, 2 $sila_3$ to 5 $sila_3$, 3(ban_2) to 2 (bariga) 1(ban_2) 1 gur to 8 gur
NI 5295	Proust 2007: pl XXXVII	Nippur	Type II, list, broken, 3(bariga) to 3 (bariga) 1(ban_2)
NI 5376	Proust 2007: 349	Nippur	Type II, list, broken, 2(bariga) 3 (ban_2) to 1 gur 4(bariga), 14 gur to 1 ($geš_2$) 30 gur
NI 5382	Proust 2007: 349, pl XXXIX	Nippur	Type II, table, broken, 3(bariga) to 11 gur, 1($geš_2$) 30 gur to 1(geš'u) 3($geš_2$) gur
NI 10005	Proust 2007: 350, pl XXXIX	Nippur	Type II, list, broken, 30 gur to 4($geš_2$) gur
NI 10009	Proust 2007: 350, pl XL	Nippur	Type II, 1 gur 1(bariga) to 2(gur), 1 (geš'u) gur to 2(geš'u) gur
NI 10062	Proust 2007: 351, pl XLI	Nippur	Type II, table, broken, 18 gin_2 to 1 $sila_3$
NI 10108	Proust 2007: 352, pl XLI	Nippur	Type II, list, broken, 1 gur to 1 gur 3 (bariga), 1($geš_2$) gur to 1($geš_2$) 50 gur
NI 10135 + CBS 10181 + CBS10207	Proust 2007: 353, pl XXLIII; Hilprecht 1906: no. 38, pl 25	Nippur	Type II, list, broken, 17 gur to 50 gur, 1(geš'u) 8($geš_2$) gur to 7($šar_2$) gur, 1 (šar'u) 8($šar_2$ to 1(šargal)^{gal} šu-nu-tag gur
NI 10204	Proust 2007: 354, pl XLIV	Nippur	Type II, table, broken, 1 1/3 gin_2 to 5 gin_2, 1 1/3 $sila_3$ to 5 $sila_3$
NI 10208	Proust 2007: 355, pl XLV	Nippur	Type II, list, broken, 8 gur to 11 gur, 5($geš_2$) gur to 1(geš'u) 2($geš_2$) gur
NI 10210	Proust 2007: 355, pl XLV	Nippur	Type II, table, broken, 10 gin_2 to 17 gin_2, 3(ban_2) 1(bariga) 3(ban_2)

3.A.b Weight

Museum or publication number	Publication	Provenance	Description
Ashm 1923-410	Robson 2004b: 22, 23	Larsa?	Type III, standard table, 1/2 še to 20 še
HS 235	Proust 2008: 40, pl 18; Hilprecht 1906: no. 31, pl 21	Nippur	Type II, table, broken, 16 še to igi 6 gal_2 10 še

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Museum or publication number	Publication	Provenance	Description
HS 242	Proust 2008: 41, pl 18; Hilprecht 1906: no. 32, pl 21	Nippur	Type III, table, broken, 20 še to 1 5/6 gin_2
HS 244	Proust 2008: 41, pl 19; Hilprecht 1906: no. 41, pl 27	Nippur	Type III, table, broken, 1/3 ma-na to 1 5/6 ma-na, 19 ma-na to 1 gu_2
HS 247	Proust 2008: 31, pl 9	Nippur	Type II, list, broken, 5 ma-na to 50 ma-na, 1 gu_2 ku_3-babbar to 15 gu_2
HS 249 + 1805	Proust 2008: 23–25, pl 2, 3	Nippur	Type I, standard, complete list, broken
HS 1718	Proust 2008: 30, pl 9	Nippur	Type II, 7($šar_2$) gur to 9($šar_2$) gur, 25 še to 29 še
NI 768	Proust 2007: 329, pl 1	Nippur	Type II, broken list, 30 ma-na to ?
NI 1082	Proust 2007: 329, pl 2	Nippur	Type II, broken list, 10 ma-na to 14 ma-na
NI 2357	Proust 2007: pl III	Nippur	Type II, broken table 15 še to 20 še
NI 3244	Proust 2007: X	Nippur	Type II, table, broken, 5/6 ma-na to 1 5/6 ma-na
NI 3515	Proust 2007: pl XII	Nippur	Type II, list, broken, 21 še to igi 6 gal_2 10 še, 1 ma-na to 2 ma-na
NI 3742	Proust 2007: pl XVIII	Nippur	Type II, list broken, 1/2 še ku_3-babbar to 6 še
NI 3909	Proust 2007: 339, pl XX	Nippur	Type II, list broken, 30 ma-na to 50 ma-na
NI 5196	Proust 2007: pl XXXIII	Nippur	Type II, list, broken, 1/3 gin_2 to 5/6 gin_2, 15 gin_2 to 1/3 ma-na, 13 ma-na to 19 ma-na
NI 10135 + CBS 10181 + CBS10207	Proust 2007: 353, pl XXLIII; Hilprecht 1906: pl 25	Nippur	Type II, list, broken, 1 še to 3 še
NI 10213	Proust 2007: 356, pl XLVI	Nippur	Type II, probably table based on spacing at end of line, broken, 1 ma-na to 4 ma-na
NI 10219	Proust 2007: pl XLVI	Nippur	Type II, table, broken, 1 1/3 gin_2 to 4 gin_2
Plimpton 317	Robson 2002: 268	Larsa?	Type III, table of weights, 1 še to 14 še

3.A.c Area

Museum or publication number	Publication	Provenance	Description
Uncertain	Hilprecht 1906: no. 40, pl 26	Nippur	Type III, table, broken, 1(aš) GAN_2 to 2 (bur_3) GAN_2
Ashm 1923-414	Robson 2004b: 23	Larsa?	Type III, standard table, 1($šar_2$) GAN_2 to 2($šar_2$) GAN_2
HS 240	Proust 2008: 42, pl 19	Nippur	Type III, table, broken, 1(aš) GAN_2 to 2 (bur_3) gan_2
HS 249 + 1805	Proust 2008: 23–25, pl 2, 3	Nippur	Type I, standard + height?, complete list, broken
HS 257 + 275	Proust 2008: 24, 25, pl 4	Nippur	Type I, list, broken, 3 gin_2-13 gin_2, 1 (ban_2) 3 $sila_3$ to 1(ban_2) 9 $sila_3$, 10 to 12 sar
HS 262 + CBS 8222	Proust 2008: 44, pl 21	Nippur	Type III, table, broken, 1(aš) GAN_2 to 2 (bur_3) GAN_2
NI 3227	Proust 2007: pl X	Nippur	Type II, table, 1(aš) GAN_2 to 2(aš) 1 (ubu) GAN_2
NI 3539	Proust 2007: 335, pl XIII	Nippur	Type II, list, broken, 2/3 sar to 1 1/2 sar
NI 5233	Proust 2007: 346	Nippur	Type II, table, broken, 1/3 sar to 1 sar
NI 5263	Proust 2007: 347, pl XXXVI	Nippur	Type II, list, broken, 5 sar to 9 sar
NI 5295	Proust 2007: pl XXXVII	Nippur	Type II, list, broken, 1($šar_2$) GAN_2 to 1 ($šar_2$) 4(bur'u) GAN_2
NI 5303	Proust 2007: 348, pl XXXVII	Nippur	Type II, list$^?$, broken, 1/3 sar to 1 sar

3.A.d Length

Museum or publication number	Publication	Provenance	Description
AO 08865	Proust 2005	Larsa?	Prism, combined table length, height?, square roots, cube roots
Ashm 1923-366	Robson 2004b: 19–22	Larsa?	Prism, combined table, length, height, square roots, cube roots

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Museum or publication number	Publication	Provenance	Description
BM 92698	Neugebauer 1935–1937: I 69; cf. Friberg 2000: 156 for description	Larsa	Type I standard table lengths, heights, squares, square and cube roots, no copy
HS 237	Proust 2008: 43, pl 20; Hilprecht 1906: no. 43, pl 28	Nippur	Type III, broken, 1/2 danna to 10 danna
HS 241	Proust 2008: 42, pl 20; Hilprecht 1906: no. 42, pl 27	Nippur	Type III, table, 1 šu-si to 2 $kuš_2$
HS 249 + 1805	Proust 2008: 23–25, pl 2, 3	Nippur	Type I, standard + height?, complete list, broken
NI 3227	Proust 2007: pl X	Nippur	Type II, table broken, 1 1/2 danna to 2 danna
NI 3352	Proust 2007: 352, pl XI	Nippur	Type II, list broken, 5 danna to 7 danna
NI 3960	Proust 2007: 340, pl XXI	Nippur	Type II, table, broken, 1 šu-si to 7 šu-si
NI 5072	Proust 2007: pl XXIX	Nippur	Type II, table, broken, 4 1/2 ninda to 8 1/2 ninda
NI 10112	Proust 2007: pl XLI	Nippur	Type II, table, broken, 3 $kuš_3$ to 1/2 ninda 2 $kuš_3$
NI 10207	Proust 2007: 354, pl XLIV	Nippur	Type II, table, broken, 1 šu-si to 1/3 $kuš_3$ 1 šu-si
NI 10215	Proust 2007: XLVI	Nippur	Type III, table, broken, 1 1/3 $kuš_3$ to 1 2/3 $kuš_3$
NI 10219	Proust 2007: pl XLVI	Nippur	Type II, table, broken, 1/2 ninda 2 $kuš_3$ to 3 ninda
UET 7, 114	Friberg 2000: 154, 155	Ur	Type I?, complete table of length, lower broken but restored, corners broken
UET 7, 115	Friberg 2000: 155, 156	Ur	Type I, combined length and height, fragmentary

3.A.e Height

Museum or publication number	Publication	Provenance	Description
Ashm 1923-366	Robson 2004b: 19–22	Larsa?	Prism, combined table, length, height, square roots, cube roots

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Museum or publication number	Publication	Provenance	Description
AO 08865	Proust 2005	Larsa?	Prism, combined table length, height?, square roots, cube roots
BM 92698	Neugebauer 1935–1937: I 69; cf. Friberg 2000: 156 for description	Larsa	Type I, standard table lengths, heights, squares, square and cube roots, no copy
HS 243	Proust 2008: 43, pl 21; Hilprecht 1906: no. 41, pl 27	Nippur	Type III, table, broken, 1 šu-si to 1 ninda
HS 249 + 1805	Proust 2008: 23–25, pl 2, 3	Nippur	Type I, standard + height?, complete list, broken
NI 3703 + UM 29-15-483 + N3901	Proust 2007: XVI	Nippur	Type III, table, broken, 2 kuš$_3$ to 5 ninda
NI 4908	Proust 2007: pl XXVII	Nippur	Prism, table, fragment, 6 uš to 2/3 danna
UET 7, 115	Friberg 2000: 155, 156	Ur	Type I, combined length and height, fragmentary

3.B Numerical Tables

Here numerical tables are catalogued. Like with metrological lists and tables, much evidence for the city of Nippur is drawn from Proust (2007, 2008). Robson (2004b) presents evidence from Larsa which, as stated in Chap. 1, lacks provenance and thus is uncertain. Evidence for Ur is suggested from Robson (1999) as well as Friberg (2000). Below is a breakdown of text listing museum number first, that is, where the document itself is located, then publication, that is where it appears, provenance and finally a description of the text. Division is by numerical reciprocal table, multiplication, squares, square roots and cube roots.

3.B.a Reciprocals

Museum or publication number	Publication	Provenance	Description
Uncertain	Hilprecht 1906: no. 24, pl 14	Nippur	Type II, reciprocals, ×45, ×40, ×30
CBS 11368	Hilprecht 1906: no. 21, pl 10	Nippur	Type II, reciprocals, ×50, broken

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Museum or publication number	Publication	Provenance	Description
HS 184	Proust 2008: 57, pl 35	Nippur	Type II, reciprocals, ×44:26:40
HS 202a	Proust 2008: 45, 46, pl 22, 23	Nippur	Type I, reciprocals, standard multiplication 50 through 8:20, mistakes
HS 203	Proust 2008: 56, 57, pl 33, 34	Nippur	Type II, reciprocals, standard multiplications, ×16:40 to ×50, mistakes
HS 204	Proust 2008: 47, pl 21	Nippur	Type I, reciprocals, standard multiplication ×50 through ×24, broken
HS 205	Proust 2008: 55, pl 32	Nippur	Type II, Reciprocals, ×30, ×25, ×24
HS 206 + 268a + 272 + 273	Proust 2008: 48, 49, pl 25	Nippur	Type I, reciprocals, ×50 to ×20, fragments
HS 1852	Proust 2008: 57, pl 35	Nippur	Type III, reciprocals, ×50, broken
NI 2733	Proust 2007: pl V, VI	Nippur	Type I, reciprocals, standard multiplication × 45 through ×1:15, squares, broken
NI 5169	Proust 2007: pl XXX	Nippur	Type II[?], reciprocals, ×50
NI 5173	Proust 2007: pl XXXI	Nippur	Type I, reciprocals, ×50, ×45, 44:26:40, ×40, ×30, ×25, ×24, ×22:30
NI 5185	Proust 2007: pl XXXIII	Nippur	Type III, reciprocals
NI 10239	Proust 2007: pl XLVIII	Nippur	Type III, reciprocals
UET 6/2 233	Robson 1999: 253; Friberg 2000: 125	Ur	Type IV, procedure table with reciprocal pair 10 and 6
UET 6/2 236	Robson 1999: 253; Friberg 2000: 122–124	Ur	Type IV, procedure table with reciprocal pair 10 and 6, and 2 and 30 as well as 40 and 1:30
UET 6/2 247	Robson 1999: 254; Friberg 2000: 125	Ur	Type IV, procedure table with 6:40 and reciprocal pair exercise 2 and 30
UET 6/2 254	Robson 1999: 254; Friberg 2000: 125	Ur	Type IV, procedure table with reciprocal pair 10 and 6
UET 6/2, 265 rev	Robson 1999: 248	Ur	Type IV, tabular exercise, reciprocal pairs 5 and 12, 4 and 15, 2 and 30, 3 and 20

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Museum or publication number	Publication	Provenance	Description
UET 6/2, 267 obv	Robson 1999: 247	Ur	Type IV, tabular exercise, written in margin, 1:21 and 44:26:40, mistakenly wrote 1:31 instead of 1:21
UET 6/2 293	Robson 1999: 254; Friberg 2000: 125	Ur	Type IV, procedure table with reciprocal pair 10 and 6, 5 and 12, and 2 and 30
UET 6/2 298	Robson 1999: 255; Friberg 2000: 125	Ur	Type IV, procedure table with reciprocal pair 10 and 6, 2 and 30, and 3 and 20.
UET 6/2, 371 rev	Robson 1999: 249	Ur	Type IV, tabular exercise with 54 and 1:6:40
UET 6/2, 387 rev	Robson 1999: 249	Ur	Type IV, procedure table with reciprocals 8 and 7:30 as well as 32 and 1:52:30

3.B.b Multiplication

Museum or publication number	Publication	Provenance	Description
Uncertain	Hilprecht 1906: no. 23, pl 13	Nippur	Type II$^{?}$, ×22:30, ×18, ×16:40, ×16, ×12, ×10, ×8:20, ×8, ×7:12
Uncertain	Hilprecht 1906: no. 24, pl 14	Nippur	Type II, ×45, ×40, ×30
Ashm 1922-178	Robson 2004b: 13	Larsa?	Type III, ×25, ×20
Ashm 1923-318	Robson 2004b: 18	Larsa?	Type III, ×8 bottom broken at 50
Ashm 1924-447	Robson 2004b: 13, 14	Larsa?	Type III, ×24
Ashm 1924-450	Robson 2004b: 16	Larsa?	Type III, ×12
Ashm 1924-451	Robson 2004b: 15	Larsa?	Type III, ×24
Ashm 1924-457	Robson 2004b: 17, 18	Larsa?	Type III, ×7:12
Ashm 1924-472	Robson 2004b: 16, 17	Larsa?	Type III, ×10

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Museum or publication number	Publication	Provenance	Description
CBS 6063	Hilprecht 1906: no. 4, pl 2	Nippur	Type III, ×18, broken
CBS 8535	Hilprecht 1906: no. 3, pl 2	Nippur	Type III, ×9, worn
CBS 8537	Hilprecht 1906: no. 7, pl 5	Nippur	Type III, ×36, broken
CBS 10190	Hilprecht 1906: no. 11, pl 5	Nippur	Type III, ×2:30
CBS 11340 + 11402 + UM 29-16-752	Hilprecht 1906: no. 20, pl 10, 11	Nippur	Type II, ×45, broken
CBS 11368	Hilprecht 1906: no. 21, pl 10	Nippur	Type II, reciprocals, ×50, broken
CBS 11902	Hilprecht 1906: no. 22, pl 12	Nippur	Type I, reciprocals, ×50, ×22:30, ×18, ×16
HS 184	Proust 2008: 57, pl 35	Nippur	Type II, reciprocals, ×44:26:40
HS 202a	Proust 2008: 45, 46, pl 22, 23	Nippur	Type I, reciprocals, standard multiplication ×50 through ×8:20, mistakes
HS 203	Proust 2008: 45, pl 33, 34	Nippur	Type II, reciprocals, standard multiplications, ×16:40 to ×50, mistakes
HS 204	Proust 2008: 47, pl 21	Nippur	Type I, reciprocals, standard multiplication ×50 through ×24, broken
HS 205	Proust 2008: 55, pl 32	Nippur	Type II, Reciprocals, ×30, ×25, ×24
HS 206 + 268b + 272 + 273	Proust 2008: 48, pl 25	Nippur	Type I, reciprocals, ×50 to ×20, fragments
HS 207	Proust 2008: 57, pl 35	Nippur	Type II, ×16, ×22:30, ×24, broken
HS 208	Proust 2008: 50, 51, pl 28, 29	Nippur	Type I, standard multiplication, ×12 to ×8, broken, mistakes
HS 209	Proust 2008: 53, pl 30, 31	Nippur	Type I, standard multiplication, ×6:40 to ×1:15
HS 210	Proust 2008: 52, pl 29	Nippur	Type I, ×5, ×4, ×3, ×2:30, ×2:24, ×2, broken
HS 211	Proust 2008: 58, pl 35; Hilprecht 1906: no. 6, pl 3	Nippur	Type III, ×30, broken

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Museum or publication number	Publication	Provenance	Description
HS 212	Proust 2008: 54, pl 32	Nippur	Type II, ×25, ×30, broken
HS 213	Proust 2008: 59, pl 36	Nippur	Type III, ×24, broken
HS 214a	Proust 2008: 59, pl 36; Hilprecht 1906: no. 5, pl 3	Nippur	Type III, ×18
HS 214b	Proust 2008: 60, pl 36	Nippur	Type III, ×18
HS 215	Proust 2008: 60, pl 37	Nippur	Type III, ×12:30, first line of ×12
HS 216	Proust 2008: 61, pl 37	Nippur	Type III, ×12, first line of ×10
HS 217a	Proust 2008: 61, pl 37; Hilprecht 1906: no. 15, pl 7	Nippur	Type III, ×9, first line of ×8:20
HS 218	Proust 2008: 62, pl 38; Hilprecht 1906: no. 13, pl 6	Nippur	Type III, ×7:12, broken, erasures
HS 220	Proust 2008: 62, pl 38	Nippur	Type III, ×3:20, beginning of ×3, worn
HS 222a	Proust 2008: 63, pl 39; Hilprecht 1906: no 1, pl 1	Nippur	Type III, ×2
HS 223	Proust 2008: 64, pl 39; Hilprecht 1906: no. 8, pl 4	Nippur	Type III, ×1:30
HS 246	Proust 2008: 49, pl 26, 27	Nippur	Type I, standard multiplication, ×40 to ×10, broken
HS 263	Proust 2008: 54, pl 32	Nippur	Type II, ×9, broken
HS 265	Proust 2008: 57, pl 35	Nippur	Type II, ×2, broken
HS 1852	Proust 2008: 57, pl 35	Nippur	Type III, reciprocals, ×50, broken
IM 077365	Arnaud 1994: 66	Larsa	Type III, ×40, ×33, broken
IM 073381	Arnaud 1994: 81	Larsa	Type I, combined table fragment, ×25, ×22:30, ×20
NI 894 / HS 217b	Hilprecht 1906: no. 14, pl 7	Nippur	Type III, ×7:30, broken
NI 1911	Proust 2007: pl III	Nippur	Type III, ×7:12, broken
NI 2208	Proust 2007: pl III	Nippur	Type III, ×7, broken

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Museum or publication number	Publication	Provenance	Description
NI 2726	Proust 2007: pl IV	Nippur	Type II, ×44:26:40, ×50, ×45, broken
NI 2733	Proust 2007: pl V, VI	Nippur	Type I, reciprocals, standard multiplication ×45 through ×1:15, squares, broken
NI 2739	Proust 2007: pl VII	Nippur	Type II, ×8, ×7:30, ×7, square roots, broken
NI 2937	Proust 2007: pl VII	Nippur	Type II, ×50, ×18, broken
NI 2938	Proust 2007: pl VII	Nippur	Type II, ×7:30, broken
NI 3179	Proust 2007: 330, pl VIII-IX	Nippur	Type II, reciprocals, ×50, ×45, ×44:26:40, ×40, ×36, ×30, ×25, ×22:30, ×18, broken, very unskilled hand
NI 4898	Proust 2007: pl XXVII	Nippur	Type uncertain, ×5, ×4, ×3:20
NI 5169	Proust 2007: pl XXX	Nippur	Type II[?], reciprocals, ×50
NI 5173	Proust 2007: pl XXXI	Nippur	Type I, reciprocals, ×50, ×45, 44:26:40, ×40, ×30, ×25, ×24, ×22:30
NI 5235	Proust 2007: 346, pl XXXV	Nippur	Type II, broken, ×7:30, ×7, ×6
NI 5327	Proust 2007: 348, pl XXXVII	Nippur	Type II, broken, ×22:30
NI 10042	Proust 2007: 35, pl XL	Nippur	Type II, broken, ×40, ×45
NI 10223	Proust 2007: 356, pl XLVII	Nippur	Type II, broken, ×50, ×44:26:40
UET 6/2 233	Robson 1999: 253; Friberg 2000: 125	Ur	Type IV, procedure table with reciprocal pair 10 and 6
UET 6/2 236	Robson 1999: 253; Friberg 2000: 122–124	Ur	Type IV, procedure table with reciprocal pair 10 and 6, and 2 and 30 as well as 40 and 1:30
UET 6/2 247	Robson 1999: 256; Friberg 2000: 133, 134	Ur	Type IV, procedure table with 6:40 and reciprocal pair exercise 2 and 30
UET 6/2 254	Robson 1999: 254; Friberg 2000: 125	Ur	Type IV, procedure table with reciprocal pair 10 and 6
UET 6/2, 265 rev	Robson 1999: 248	Ur	Type IV, tabular exercise, reciprocal pairs 5 and 12, 4 and 15, 2 and 30, 3 and 20

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Museum or publication number	Publication	Provenance	Description
UET 6/2, 267 obv	Robson 1999: 247	Ur	Type IV tabular exercise, written in margin, 1:21 and 44:26:40, mistakenly wrote 1:31 instead of 1:21
UET 6/2 269	Robson 1999: 256; Friberg 2000: 134, 135	Ur	Type IV, procedure table with 6:40 and reciprocal pair exercise 2 and 30
UET 6/2 293	Robson 1999: 254; Friberg 2000: 125	Ur	Type IV, procedure table with reciprocal pair 10 and 6, 5 and 12, and 2 and 30
UET 6/2 298	Robson 1999: 255; Friberg 2000: 125	Ur	Type IV, procedure table with reciprocal pair 10 and 6, 2 and 30, and 3 and 20
UET 6/2, 387 rev	Robson 1999: 249	Ur	Type IV procedure table with reciprocals 8 and 7:30 as well as 32 and 1:52:30
YBC 11924	Robson 2004b: 15, 16	Larsa?	Type III ×4

3.B.c Squares

Museum or publication number	Publication	Provenance	Description
BM 92680	Neugebauer 1935–1937: 69	Larsa	Type I standard table squares, square and cube roots-no copy
BM 92698	Neugebauer 1935–1937: 69	Larsa	Type I standard table lengths, heights, squares, square and cube roots-no copy
HS 224	Proust 2008: 64, pl 40; Hilprecht 1906: no. 26, pl 16	Nippur	Type III, squares
HS 225	Proust 2008: 65, pl 40	Nippur	Type III, squares
NI 2649	Proust 2007: pl IV	Nippur	Type uncertain, table of squares, broken
NI 2733	Proust 2007: pl V, VI	Nippur	Type I, reciprocals, standard multiplication ×45 through ×1:15, squares, broken

3.B.d Square Roots

Museum or publication number	Publication	Provenance	Description
Ashm 1923-366	Robson 2004b: 19–22	Larsa?	Prism, combined table, length, height, square roots, cube roots
AO 08865	Thureau-Dangin 1930: 73–78; Proust 2005	Larsa?	Prism, combined table length, height?, square roots, cube roots
BM 92680	Neugebauer 1935–1937: I 70	Larsa?	Type III standard table squares, square and cube roots—no copy, cf CDLI image (P254447)
BM 92698	Neugebauer 1935–1937: I 69; cf. Friberg 2000: 156 for description	Larsa	Type I standard table lengths, heights, squares, square and cube roots, no copy
CBS 19813	Hilprecht 1906: no. 27, pl	Nippur	Type I, square roots
HS 226 + 227	Proust 2008: 70, pl. 42; Hilprecht 1906: no. 2, pl 1; no. 28 pl 16	Nippur	Type III, square roots, broken
HS 253f	Proust 2008: 67, pl 41	Nippur	Type III, square roots, broken
HS 254	Proust 2008: 69, pl 42	Nippur	Type III, square roots, broken
HS 2466	Proust 2008: 68, pl 42	Nippur	Type III$^{?}$, square roots, broken
NI 4775	Proust 2007: pl XXIV	Nippur	Type uncertain, square roots

3.B.e Cube Roots

Museum or publication number	Publication	Provenance	Description
Ashm 1923-366	Robson 2004b: 19–22	Larsa?	Prism, combined table, length, height, square roots, cube roots
AO 08865	Thureau-Dangin 1930: 73–78; Proust 2005	Larsa?	Prism, combined table length, height?, square roots, cube roots
BM 92680	Neugebauer 1935–1937: I 70	Larsa?	Type, III, standard table squares, square and cube roots—no copy, cf CDLI image (P254447)
BM 92698	Neugebauer 1935–1937: I 69, cf. Friberg 2000: 156 for description	Larsa?	Type I, standard table lengths, heights, squares, square and cube roots, no copy
NI 2739	Proust 2007: pl VII	Nippur	Type II, ×8, ×7:30, ×7, square roots

Appendix 4
Price and Wage Index and Charts

In this appendix prices and wages are presented as stated or suggested in economic texts from the kingdom of Larsa, dated before and after *Hammu-rābi* conquered the kingdom. Section 4.Alists prices in silver, Sect. 4.Blists prices in grain, while Sect. 4.Clists wages. Entries are listed by tablet and arranged by date. Each entry in the tables below is presented by museum number, then by the transaction's date, the line number it appears in the text, the in-kind value of each commodity or wage, SPVN equivalent of this in-kind value, in-silver or -grain value, then this value's SPVN equivalent, the price or wage rate and in the two last columns SPVN transformations appear, which form a reciprocal pair. Underline denotes values or numbers not explicitly stated in a text and thus a modern reconstruction. When stating SPVN reciprocal pairs, NR abbreviates 'No Reciprocal'.

Charts appear in this appendix and state rates as attested or suggested in the economic and administrative texts from the kingdom of Larsa before and after *Hammu-rābi* conquered this kingdom. There are six charts, four representing price or equivalencyrates as stated in the text (Charts 1, 2, 3 and 4) and then two representing wages (Charts 5 and 6). Charts 1 and 2 present all prices as stated or suggested by the texts while Charts 3 and 4 represent only rates that are expressly stated in the text themselves. Charts 1, 3 and 5 present rates as expressed by measurement values while Charts 2, 4 and 6 present these same rates as reciprocal pairs.

R. Middeke-Conlin, *The Making of a Scribe*, Why the Sciences of the Ancient World Matter 4, https://doi.org/10.1007/978-3-030-35951-5

4.A Prices, Silver

Museum number	Date (year, month, day)	Lines	In-kind value	SPVN equivalent	In-silver value	SPVN equivalent	Rate	In-kind rate SPVN	In-silver rate SPVN
YBC 04224	*Gungunum* ?	26, 27	2 × 60 + 20 *gur* sesame	*11:40*	14 *mana*	*14*	5 *ban* per (*gin*)	*50*	1:12
		41	35 *gur* sesame	*2:55*	5 1/2 *mana*	*5:30*		NR	NR
NBC 08014	*Sîn-iddinam* 06, month 11, day 15	1–3	3 2/3 *gin* gold	*3:40*	1/2 *mana* 6 1/2 *gin*	*36:30*	10 *gin* per (*gin*)	6	*10*
LB 1092	*Rīm-Sîn* ?	1	1 × 60 *gur* of grain	*5*	[5/6] *mana*	[*50*]	1 *gur* 1 *bariga* per *gin*	6	10
AO 08475	*Rīm-Sîn* ?	10	1 *ban* 5 *sila* 10 *gin* oil and butter	*15:10*	1 1/2 *gin*	*1:30*	1 *ban* 5 2/3 *gin* per *gin*	10:6:40	NR
		13	A premium female slave	*1*	16 1/2 *gin*	*16:30*	16 1/2 *gin* per unit	NR	16:30
Ashm 1923-315	*Rīm-Sîn* ?	1, 2	4 *gur* 4 *ban*	*20:40*	5 *gin*	*5*	4 *bariga* 8 *sila* per *gin*	4:8	NR
Ashm 1922-336	*Rīm-Sîn* 01, month 09, day 19	1, 2	3 *ban* grain	*30*	1/2 *gin*	*30*	1 *bariga* per *gin*	1	1
AO 06760	*Rīm-Sîn* 02, month 05, day 30	3–5	2 × 60 sesame	*10*	8 *mana*	*8*	1 *bariga* 1 *ban* 5 *sila* per (*gin*)	*1:15*	48
		6–9	10 *gu* average wool	*10*	1 *mana*	*1*	10 *mana* per (*gin*)	*10*	6
		13, 14	6 *gu* copper	*6*	1 *mana*	*1*	6 *mana* (per *gin*)	*6*	10
		15	2 bracelets of silver	*2*	1/3 *mana*	*20*	10 *gin* per unit	6	10
		16	1 robe	*1*	3 *gin*	*3*	3 *gin* per unit	20	3
		18, 19	4 *gin* gold	*4*	1/2 *mana* 6 *gin*	*36*	9 *gin* per (*gin*)	6:40	*9*
		21, 22	3 *bariga* butter	*3*	12 [*gin*]	*12*	1 *ban* 5 sila per (*gin*)	*15*	4

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Museum number	Date (year, month, day)	Lines	In-kind value	SPVN equivalent	In-silver value	SPVN equivalent	Rate	In-kind rate SPVN	In-silver rate SPVN
		24, 25	20 various garments	*20*	1 *mana*	*1*	3 *gin* per (unit)	20	3
		26, 27	10 various garments	*10*	5/6 *mana*	*50*	5 *gin* per (unit)	12	*5*
		29–31	1 sixties hairy barsig garments	*2*	1/2 *mana*	*30*	one-4th per (unit)	4	*15*
		33	1 × 60 rams	*1*	1/3 *mana*	*20*	1/3 *gin* per (unit)	3	20
		36, 37	2 *gu* bronze	*2*	1/3 *mana*	*20*	6 *mana* per (*gin*)	*6*	10
		39, 40	2 *gin* gold	*2*	14 *gin*	*14*	7 *gin* per (*gin*)	NR	*7*
		42, 43	1 *bariga* 3 *ban* butter	*1:30*	6 *gin*	*6*	1 *ban* 5 *sila* per (*gin*)	*15*	4
		45–47	1/3 *mana* 9 5/6 *gin* gold	*29:50*	3 1/3 *mana* 8 5/6 *gin*	*3:28:50*	7 *gin* per (*gin*)	NR	*7*
		49–51	18 5/6 *gin* 25 *še* gold	*18:58:20*	2 *mana* 11 1/2 *gin* 25 *še*	*2:11:38:20*	7 *gin* per (*gin*)	NR	*7*
		53	2 assorted garments	*2*	5 1/2 *gin*	*5:30*	2 2/3 *gin* 15 *še* per unit	NR	2:45
		54	5 rams	*5*	4 2/3 *gin*	*4:40*	5/6 *gin* 18 *še* per unit	NR	56
		55	4 *ban* butter	*40*	2 2/3 *gin*	*2:40*	1 *ban* 5 *sila* per *gin*	15	4
YBC 07477	*Rīm-Sîn* 03, month 12	36	3 × 60 *gur*	*15*	2[*mana* 15 *gin*]	*2:15*	1 *gur* 1 *bariga* 4 *ban* (per *gin*)	*6:40*	9
YBC 07473	*Warad-Sîn* 11	1–3	2 × 60 *gur* sesame	*10*	8 *mana*	*8*	1 *bariga* 1 *ban* 5 sìla per (*gin*)	*1:15*	48
		4, 5	10 *gu* average wool	*10*	1 *mana*	*1*	10 *mana* per (*gin*)	*10*	6
	Rīm-Sîn 01	7, 8	40 rams	*40*	2/3 *mana* silver	*40*	1 *gin* per 1 sheep	*1*	1
	Rīm-Sîn 02	10, 11	2 × 60 *gur* sesame	*10*	5 *mana*	*5*	2 *bariga* per (*gin*)	2	30

(continued)

(continued)

Museum number	Date (year, month, day)	Lines	In-kind value	SPVN equivalent	In-silver value	SPVN equivalent	Rate	In-kind rate SPVN	In-silver rate SPVN
	Rīm-Sîn 03	13, 14	2 × 60 *gur* sesame	*10*	5 1/3 *mana* 7 one-4th *gin* 5 *še*	*5:27:16:40*	1 *bariga* 5 *ban* per (*gin*)	*1:50*	32:43:40
	Rīm-Sîn 02	23, 24	49 various garments	*49*	2 1/3 *mana* 7 *gin*	*2:27*	3 *gin* per (unit)	20	*3*
	Rīm-Sîn 02	25, 26	10 various garments	*10*	2 1/3 *mana* 7 *gin*	*40*	4 *gin* per (unit)	15	*4*
	Rīm-Sîn 02	27	5 various large bowls	*5*	1 2/3 *mana*	*1:40*	1/3 *mana* per unit	3	20
	Rīm-Sîn 02	28, 29	quartz bead, block of quartz	*1*	1 *mana*	*1*	1 *mana* per unit	1	1
		30	2 silver rings	*2*	18 1/2 *gin*	*18:30*	9 *gin* one-4th per unit	NR	9:15
		39	2 large bowls	*2*	1/2 *mana*	*30*	15 *gin* per unit	4	15
		40	20 sarzum-garments	*20*	1 *mana* 6 2/3 *gin*	*1:6:40*	3 1/3 *gin* per unit	18	3:20
		41	20 robes	*20*	1 *mana*	*1*	3 *gin* per unit	20	3
		42, 43	2 *mana* tin	*2*	12 *gin*	*12*	10 *gin* per (*gin*)	*10*	6
	Rīm-Sîn 03	46	11 sarzum-garments	*11*	1/2 [*ma*]*na* 3 *gin*	*33*	3 *gin* per unit	20	3
		47	2 silver bracelets	*2*	1/3 *mana*	*20*	10 *gin* per unit	6	10
		49	2 sail-cloths	*2*	10 *gin*	*10*	5 *gin* per unit	12	5
	Rīm-Sîn 04, month 01, day 29	52, 53	1/2 *mana* gold	*30*	3 *mana* 15 *gin*	*3:15*	6 1/2 *gin* per (*gin*)	NR	*6:30*
		55, 56	20 sarzum-garments	*20*	5/6 *mana* 3 1/3 *gin*	*53:20*	2 2/3 *gin* per (*gin*)	22:30	*2:40*
YBC 08758	*Rīm-Sîn* 07, month 10, day 01	1, 2	5 female and male slaves	*5*	2 *gin*	*2*	1/3 *gin* 12 *še* per unit	2:30	24

(continued)

(continued)

Museum number	Date (year, month, day)	Lines	In-kind value	SPVN equivalent	In-silver value	SPVN equivalent	Rate	In-kind rate SPVN	In-silver rate SPVN
		5	5 pigs	*5*	3 *gin*	*3*	1/2 *gin* 18 *še* per unit	1:40	36
		9	2 garments	*2*	1 *gin* one-4th	*1:15*	1/2 *gin* 22 1/2 *še* per unit	1:36	37:30
AO 07034	*Rīm-Sîn* 14, month 12	6	5 sikil stones	*5*	1 1/3 *gin*	*1:20*	One-4th *gin* 3 *še* per stone	3:45	16
		7	A garment	*1*	1 *gin*	*1*	1 *gin* per unit	1	1
		8	15 copper shovels	*15*	4 1/2 *gin*	*4:30*	One-4th 9 *še* per unit	3:20	18
		19	A garment	*1*	1 *gin* 15 *še*	*1:5*	1 *gin* 15 *še* per unit	NR	15
		20, 21	4 various female and male slaves	*4*	1 *gin*	*1*	one-4th *gin* per unit	4	15
		22	1 *bariga* beer	*1*	one-4th 9 *še*	*18*	3 *bariga* 2 *ban* per *gin*	3:20	18
		26	2 *ban* beer	*20*	18 *še*	*6*	3 *bariga* 2 *ban* per *gin*	3:20	18
YBC 08748	*Rīm-Sîn* 15, month 11	1, 2	2 *sila* (cups)	*2*	1 *mana*	*1*	1/2 *mana* per unit	2	30
YBC 05793	*Rīm-Sîn* 20, month 11, day 28	1, 2	2 *gu* copper	*2*	1/2 *mana*	*30*	4 *mana* per (*gin*)	*4*	15
YBC 04730	Rīm-Sîn 21, month 12	1–4	[8 *gin* gold]	*8*	2/3 *mana*	*40*	5 *gin* per *gin*	12	5
		5–8	[8] *gin* gold	*8*	2/3 *mana*	*40*	5 *gin* per *gin*	12	5
		9–12	8 *gin* gold	*8*	2/3 *ma*[*na*]	*40*	5 *gin* per *gin*	12	5
		13–16	3 *gin* gold	*3*	15 *gin*	*15*	5 *gin* per *gin*	12	5
		17–19	3 *gin* gold	*3*	[1]5 [*gin*]	*15*	5 *gin* per *gin*	12	5
		22, 23	1/2 *mana* gold	*30*	2 1/2 *mana*	*2:30*	5 *gin* per *gin*	12	5
AO 08481	*Rīm-Sîn* 22, month 03	1–3	1 × 60 + 32 various pigs	*1:32*	1/2 *mana* 2/3 *gin*	*30:40*	1/3 *gin* per (unit)	3	*20*

(continued)

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Museum number	Date (year, month, day)	Lines	In-kind value	SPVN equivalent	In-silver value	SPVN equivalent	Rate	In-kind rate SPVN	In-silver rate SPVN
AO 07035	*Rīm-Sîn* 16, month 03, day 05	1, 2	10 barsig-garments	*10*	2 1/3 [*gin*]	*2:20*	One-6th 12 *še* per unit	NR	14
		4	4 lioness meat?	*4*	1/2 *gin*	*30*	22 1/2 *še* per unit	8	7:30
		6	3 beer jars, 2 *ban* each	*3*	1/2 *gin*	*30*	10 *gin* per unit	6	10
AO 08479	*Rīm-Sîn* 22, month 09	10	2 premium slaves	*2*	1 2/3 *gin*	*1:40*	5/6 *gin* per unit	1:12	50
		11	2 *sila* premium oil	*2*	2/3 *gin*	*40*	3 *sila* per *gin*	3	20
		12, 13	2 *sila* cedar oil	*2*	2/3 *gin*	*40*	3 *sila* per *gin*	3	20
		14, 15	5 premium plow oxen	*5*	3 2/3 *gin*	*3:40*	2/3 *gin* 12 *še* per unit	NR	44
LB 1086	*Rīm-Sîn* 23, month 11	4	4 rams	*4*	4 *gin*	*4*	1 *gin* per unit	1	1
YBC 05814	*Rīm-Sîn* 23, month 04, day 04	5–7	17 1/2 *gin* gold	*17:30*	1 1/3 *mana* 7 1/2 *gin*	*1:27:30*	5 *gin* per (*gin*)	12	*5*
AO 08464	*Rīm-Sîn* 27, month 11	2, 3	8 *gin* gold	*8*	1/2 *mana* 2 *gin*	*32*	4 *gin* (per *gin*)	15	*4*
		4, 5	5 *gin* gold	*5*	15 *gin*	*15*	3 *gin* (per *gin*)	20	*3*
		6, 7	4 *gur* 1 *ban* oil	*20:10*	1 *mana* 7 one-6th *gin* 10 *še*	*1:7:13:20*	1 *ban* 8 (sila)	*18*	3:20
		8, 9	1 *bariga* 1 *sila* premium oil	*1:1*	12 one-6th *gin* 6 *še*	*12:12*	5 *gin* (per *gin*)	*5*	12
		10	1 *ban* perfumed oil	*10*	3 1/3 *gin*	*3:20*	3 *sila* (per *gin*)	*3*	20
		11–15	40 *mana* (10 each cedar, juniper, cypress, white cedar)	*40*	3 1/3 *gin*	*3:20*	12 *mana* (per *gin*)	*12*	5

(continued)

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Museum number	Date (year, month, day)	Lines	In-kind value	SPVN equivalent	In-silver value	SPVN equivalent	Rate	In-kind rate SPVN	In-silver rate SPVN
		16, 17	4 *ban* 2 *sila* mixed perfumes	*42*	2/3 *gin* 6 *še*	*42*	1 *bariga* (per *gin*)	*1*	1
		18, 19	40 rams	*40*	1/3 *mana* 6 2/3 *gin*	*26:40*	2/3 *gin* (per unit)	1:30	*40*
		20, 21	1 × 60 + 7 rams	*1:7*	1/2 *mana* 3 1/2 *gin*	*33:30*	1/2 *gin* (per unit)	2	*30*
		22, 23	9 rams without fleece	*9*	3 *gin*	*3*	1/3 *gin* (per unit)	3	*20*
		24, 25	1 × 60 + 39 ewes	*1:39*	2/3 *mana* 9 1/2 *gin*	*49:30*	1/2 *gin* (per unit)	2	*30*
		26,27	10 ewes without fleece	*10*	2 1/2 *gin*	*2:30*	one-4th (*gin* per unit)	4	*15*
		28	16 lambs	*16*	5 1/3 *gin*	*5:20*	1/3 *gin* (per unit)	3	*20*
		29, 30	34 female x-goats	*34*	11 1/3 *gin*	*11:20*	1/3 *gin* (per unit)	3	*20*
AO 08463	*Rīm-Sîn* 31, month 05, day 14	3	1 *gin* 18 *še* gold	*1:6*	5 *gin*	*5*	one-6th *gin* 9 1/2 *še* 2 per *gin*	13:12	NR
		4	5 assorted garments	*5*	11 1/2 *gin* 14 *še*	*11:34:40*	2 *gin* one-4th 11 1/2 *še* 6 per unit	NR	2:18:56
		6	1 robe	*1*	5 1/2 *gin*	*5:30*	5 1/2 *gin* per unit	NR	5:30
		7	16 1/3 ma-na X (wool?)	*18:40*	6 *gin* one-6th	*6:10*		NR	NR
		8	2 *ban* 6 2/3 *sila* lard	*26:40*	1 1/3 *gin* 24 *š*	*1:48*	1 *ban* 4 2/3 *sila* 8 5/6 *gin* 10 *še* per *gin*	14:48:53:20	4:3
		10	4 *bariga* 1 *ban* 2 *sila* oil	*4:12*	16 2/3 gin_2	*16:40*	1 *ban* 5 *sila* 7 *gin* 1/66 *še*	15:7:12	NR
		22	A basket	*1*	15 *še*	*5*	15 *še* (per unit)	12	5
		25	3 *gur* 3 *bariga* grain	*18*	2 5/6 *gin*	*2:50*	28 1/3 *še* per *bariga* oil	NR	9:26:40
		26	7 *sila* premium oil	*7*	1 gin_2 10 še	*1:3:20*		NR	NR

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Museum number	Date (year, month, day)	Lines	In-kind value	SPVN equivalent	In-silver value	SPVN equivalent	Rate	In-kind rate SPVN	In-silver rate SPVN
		30	8 *gur* 1 *bariga gur* 5 *sila* sesame	*41:5*	1/2 *mana*	*30*	1 *bariga* 2 *ban* 2 *sila* 1/6 per *gin*	1:22:10	NR
YBC 04797	*Rīm-Sîn* 32, month 12, day 30	3	1 ram	*1*	1/2 *gin*	*30*	1/2 *gin* per unit	2	30
		4	1 *sila* oil	*1*	10 *še*	*3:20*	1 *ban* 8 *sila* per *gin*	18	3:20
		5	1 *gu* sakni-plant	*1*	15 *še*	*5*	12 *gu* per *gin*	12	5
		9	1 ewe	*1*	One-6th	*10*	One-6th (*gin*) per unit	6	10
		10	1 *gu sakni*-plant	*1*	15 *še*	*5*	12 *gu* per *gin*	12	5
LB 1088	*Rīm-Sîn* 39, month 10	1, 2	1 *gu* x x	*1*	6 1/3 *gin* 15 *še*	*6:25*	6 1/3 *gin* 15 *še* per *gu*	NR	6:25
		3, 4	5 *mana* ebony? (gišu2-šu-um)	*5*	10 *gin*	*10*	1/2 *mana* per *gin*	30	2
AO 08468	*Rīm-Sîn* 45, month 05, day 30	14, 15	9 Elamite? pots	*9*	3 *gin*	*3*	1/3 *gin* per (unit)	**3**	*20*
		24	2 rams	*2*	1 2/3 *gin*	*1:40*	5/6 *gin* per unit	1:12	50
		31	a ram	*1*	1 1/2 *gin*	*1:30*	1 1/2 *gin* per unit	40	1:30
		34	a namaššum garment	*1*	2 2/3 *gin*	*2:40*	2 2/3 *gin* per unit	22:30	2:40
		36	3 *mana* adamatum-dye	*3*	One-4th (*gin*)	*15*	12 *mana* per *gin*	12	5
		40	5 *sila* beer	*5*	15 *še*	*5*	1 *bariga* per *gin*	1	1
AO 08522	*Rīm-Sîn* 51, month 07 day 02	3, 4	20 *mana* average wool	*20*	2 *gin*	*2*	10 *mana* per *gin*	10	6
YBC 04299	*Hammu-rābi* 36, month 11, day 21	1–3	5 sixties *gur* of dates	*25*	2 1/2 *mana*	*2:30*	2 *gur* for 1 *gin*	*10*	6
		7–9	9 *gur* spice-plants	*45*	15 *gin*	*15*	3 *bariga* for 1 *gin*	*3*	20

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Museum number	Date (year, month, day)	Lines	In-kind value	SPVN equivalent	In-silver value	SPVN equivalent	Rate	In-kind rate SPVN	In-silver rate SPVN
YBC 04241	*Hammu-rābi* 37, month 02, day 28	1–5	4 *gur* garlic	*20*	5 *gin*	5	For 1 *gin* silver 4 *bariga* garlic was given	*4*	15
YBC 07744	*Hammu-rābi* 41, month 02, day 20	1–3	35 *gu* softened (dig) fish	*35*	6 *gin* one-4th	*26:15*	3 *šuši* per (*gin* fish)/4 *šuši* per (*gin* silver)	*3/4*	20/15
		4–6	15 *gu* akarkar fish	*15*	5 *gin*	*5*	10 × 60 (fish) per (*gin* fish)/ 30 × 60 (fish) per (*gin* silver)	*10/30*	6/2
		7, 8	4 *gur* simma fish	*20*	8 *gin*	*8*	2 *bariga* 3 *ban* per (*gin*)	*2:30*	24
		9, 10	5 *gur* x-fish	*25*	5 *gin*	*5*	[1 *gur* (per *gin*)]	*5*	12
		11, 12	2 *gur* x-fish	*10*	1 1/2 *gin*	*1:30*	1 *gur* 1 *bariga* 4 *ban* per (*gin*)	*6:40*	9
A.26375	*Hammu-rābi* 41, month 12	1, 2	2 *gu* 54 *mana* average wool	*2:54*	1/3 *mana* 1 2/3 *gin* 15 *še*	*21:45*		NR	NR
HE 111	*Samsu-iluna* 5, month 03, day 30	1–3	8 *gu* first quality white wool	*8*	1 *mana*	*1*	to 1 *gu* (is) 7[!] 1/2 *gin*	8	*7:30*
		11, 12	1 × 60 + 41 *gur* 1 *bariga* 4 *ban* dates	*8:26:40*	5/6 *mana* 2/3 *gin*	*50:40*	2 *gur* per (*gin*)	*10*	6
		16–18	2 *gur* garlic, sumsikil-plant, zaḫadum-plant	*10*	3 1/3 *gin*	*3:20*	3 *bariga* per (*gin*)	*3*	20
AUAM 73.2672	*Samsu-iluna* year 07, month 06, day 22	1–3	18 *gur* dates	*1:30*	9 *gin*	*9*	2 *gur* per (*gin*)	*10*	6

4.B Prices, Grain

Museum number	Date (year, month, day)	Lines	In-kind value	SPVN equivalent	In-grain value	SPVN equivalent	Rate	In-kind rate SPVN	In-grain rate SPVN
YBC 04828	Month 12, day 30	1	2 kurulum-reeds	*2*	2 *ban*	*20*	1 *ban* per unit	6	10
		3	5 giš-ne$_2$-e-reeds	*5*	4 *ban*	*40*	8 *sila* per unit	7:30	8
AO 08468	*Rīm-Sîn* 45, month 05, day 30	50	A *maḫiātum*-garment	*1*	2 *ban*	*20*	2 *ban* per unit	3	20
Ashm 1923-057	*Hammu-rābi* 38, month 01, day 01	1, 2	20 *mana* wool	*20*	5 *gur*	*25*	2/3 *mana* 8 *gin* per bariga	48	1:15

4.C Wages, Grain

Museum number	Date (year, month, day)	Lines	Labor	SPVN equivalent	Wages	SPVN equivalent	Rate	Labor rate SPVN	Grain rate SPVN
YBC 05418	*Warad-Sîn* 10, month 10	4, 5	33 [men]	*33*	1 *gur* 1 *bariga* 3 *ban* 6 *sila*	*6:36*	1 *ban* 2[!] (4) *sila* per (man)	**5**	12
		06	galzu-unkena official	*1*	1 *bariga*	*1*	1 *bariga* per man	1	1
		07	KA-mas-su-expert	*1*	1 *bariga*	*1*	1 *bariga* per man	1	1
		08	[ar]chivist	*1*	1 *ban* 2 [*sila*]	*12*	1 *ban* 2 *sila* per man	5	12
		10	[eš]abdu professional	*1*	1 *ban* 2 *sila*	*12*	1 *ban* 2 *sila* per man	5	12
		12	Tablet official (PI-dub)	*1*	1 *ban* 2 *sila*	*12*	1 *ban* 2 *sila* per man	5	12
		13	Driver	*1*	1 *ban* 2 *sila*	*12*	1 *ban* 2 *sila* per man	5	12
		14	šatammu official	*1*	[1 *ban* 2 *sila*]	*12*	1 *ban* 2 *sila* per man	5	12
		15	Oracle	*1*	1 *ban* 2 *sila*	*12*	1 *ban* 2 *sila* per man	5	12
		16	Chief musician	*1*	1 *ban* 2 *sila*	*12*	1 *ban* 2 *sila* per man	5	12
		17	Musician (nar-SA)	*1*	1 *ban* 2 *sila*	*12*	1 *ban* 2 *sila* per man	5	12
		18	Great singer	*1*	1 *ban* 2 *sila*	*12*	1 *ban* 2 *sila* per man	5	12

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Museum number	Date (year, month, day)	Lines	Labor	SPVN equivalent	Wages	SPVN equivalent	Rate	Labor rate SPVN	Grain rate SPVN
		19, 20	18 men, groups of 10, the household stewards	*18*	1 *bariga* 4 *ban* 8 *sila*	*1:48*	6 *sila* per man	10	6
		21, 22	18 musicians (and) stewards	*18*	1 *bariga* 4 *ban* 8 *sila*	*1:48*	6 *sila* per man	10	6
		23	6 doorkeepers	*6*	3 *ban* 6 *sila*	*36*	6 *sila* per man	10	6
		24	3 barbers	*3*	1 *ban* 8 *sila*	*18*	6 *sila* per man	10	6
		25	3 dumu-dab professionals	*3*	1 *ban* 8 *sila*	*18*	6 *sila* per man	10	6
Ashm 1922-337	*Rîm-Sîn* 01, month 08, day 23	1–3	20 men	*20*	1 *gur* flour	*5*	1 *ban* 5 *sila* per man	4	15
Ashm 1922-325	*Rîm-Sîn* 01, month 09, day 16	1, 2	10 days guard	*10*	2 *bariga* 3 *ban*	*2:30*	1 *ban* 5 *sila* per man	4	15
YBC 07195	*Rîm-Sîn* 06, month 12	6	6 ox-drivers	*6*	30 *gur*	*2:30*	2 *ban* 5 *sila* per man	2:24	25
LB 1074	*Rîm-Sîn* 38, month 01, day 29	1	43 men, binders	*43*	2 *gur* 4 *bariga* 2 *ban*	14:20	2 ban per (man)	3	*20*
		3	32 grain gatherers	*32*	1 *gur* 2 *ban*	5:20	1 ban per (man)	6	*10*

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Museum number	Date (year, month, day)	Lines	Labor	SPVN equivalent	Wages	SPVN equivalent	Rate	Labor rate SPVN	Grain rate SPVN
		5	5 men threshers	*5*	5 *ban*	50	1 *ban* per man	6	10
		6	2 people who put the threshing floors in order	*2*	2 *ban*	20	1 *ban* per man	6	10
		10	5 men, laborers who carried building reeds	*5*	1 *bariga* 4 *ban*	*1:40*	2 *ban* per man	3	20
		12	7 *redum*	*7*	1 *ban* 4 *sila*	*14*	2 *sila* per man	30	2
		13	5 men, craft and labor comptroller	*5*	1 *ban*	*10*	2 *sila* per man	30	2
		14	3 men, doorkeepers	*3*	6 *sila*	*6*	2 *sila* per man	30	2
		15	25 men, ox drivers	*25*	5 *ban*	*50*	2 *sila* per man	30	2
LB 1078	*Rîm-Sîn* 38, month 02, day 09?	1	8 men	*8*	1 *bariga* 3 *ban* 6 *sila*	1:36	1 *ban* 2 *sila* per (man)	5	*12*
		2	12 men basket menders	*12*	4 *ban* 8 *sila*	48	4 *sila* per (man)	15	*4*
		6, 7	1 man thresher	*1*	1 *ban* 2 *sila*	*12*	1 *ban* 2 *sila* per (man)	5	*12*
		9	9 men	*9*	1 *bariga* 4 *ban* 8 *sila*	1:48	1 *ban* 2 *sila* per (man)	5	*12*

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Museum number	Date (year, month, day)	Lines	Labor	SPVN equivalent	Wages	SPVN equivalent	Rate	Labor rate SPVN	Grain rate SPVN
		10	12 men grain pilers	*12*	4 *ban* 8 *sila*	48	4 *sila* per (man)	15	*4*
		14	22 men ox drivers	*22*	4 *ban* 4 *sila*	*44*	2 *sila* per man	30	2
		15	7 men craft and labor comptroller	*7*	1 *ban* 4 *sila*	*14*	2 *sila* per man	30	2
		16	5 men *rēdûm*	*5*	1 *ban*	*10*	2 *sila* per man	30	2
		17	2 house servant(s)	*2*	4 *sila*	*4*	2 *sila* per man	30	2
		18	1 carpenter	*1*	2 *sila*	2	2 *sila* per man	30	2
		19	1 man, hired hand	*1*	2 *sila*	2	2 *sila* per man	30	2
LB 1069	*Rîm-Sîn* 38, month 13, day 25	1, 2	19 men, corn cutters	19	1 *gur* 1 *bariga* 2 *ban*	*6:20*	2 *ban* per man	3	20
		3, 4	16 men, binders	16	4 *bariga*	*4*	1 *ban* 5 *sila* per man	4	15
		5, 6	48 men, gatherers	48	1 *gur* 3 *bariga*	*8*	1 *ban* per man	6	10

4.D Charts

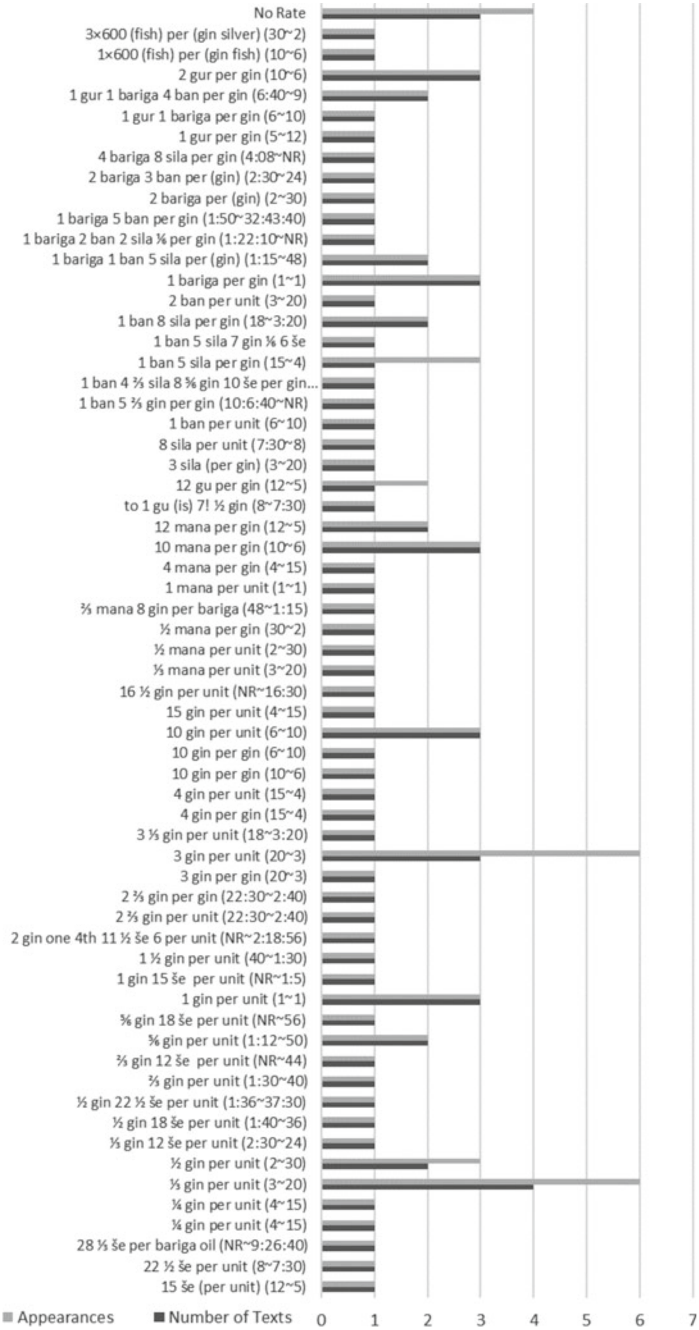

Chart 1 Weight/capacity rate distribution by all metrological unit

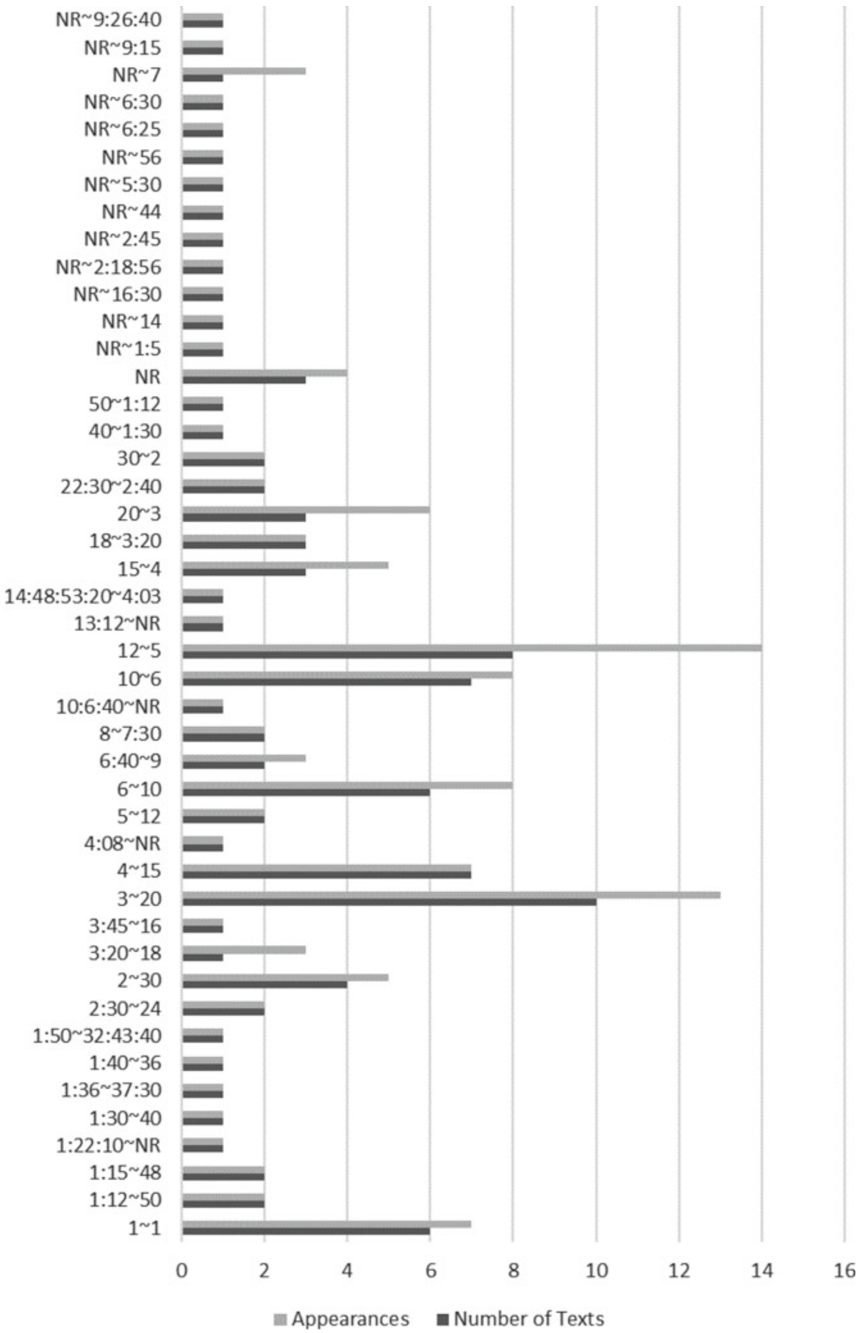

Chart 2 Weight/capacity rate distribution by all reciprocal pair

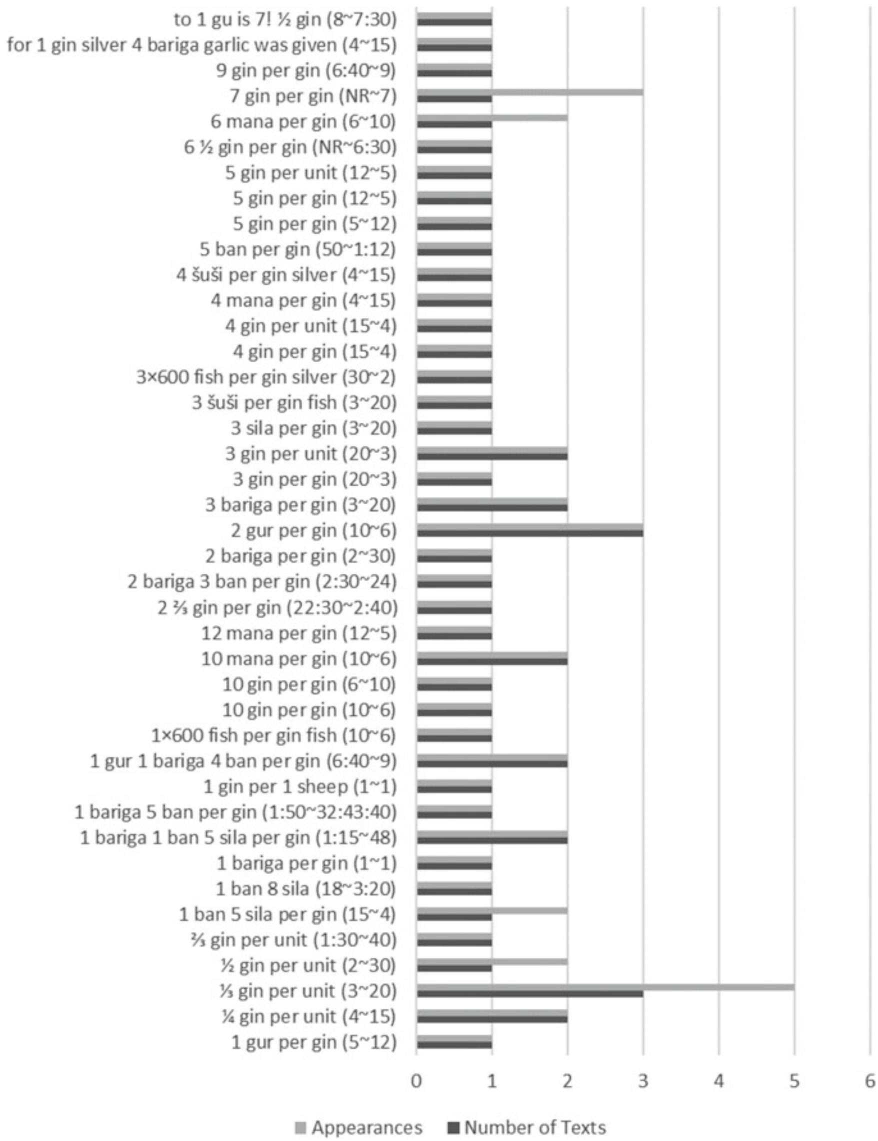

Chart 3 Weight/capacity rate distribution by stated metrological unit

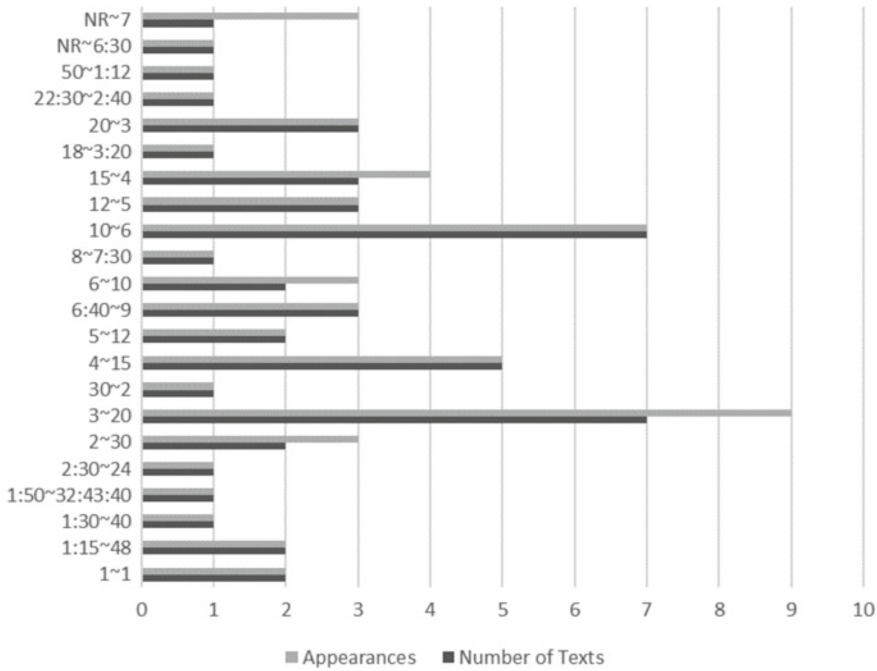

Chart 4 Weight/capacity rate distribution by stated reciprocal pair

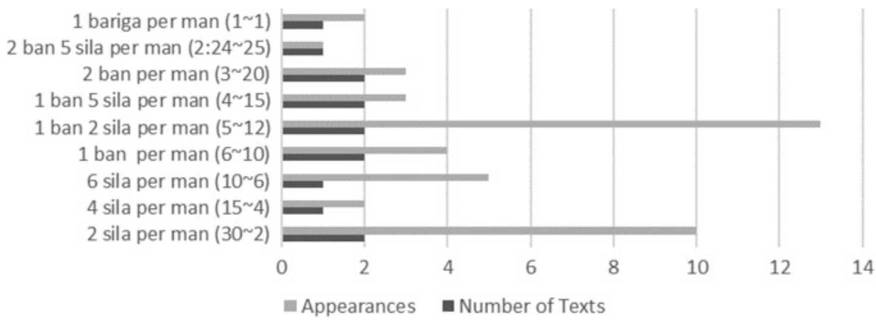

Chart 5 Wage rate distribution by all metrological unit

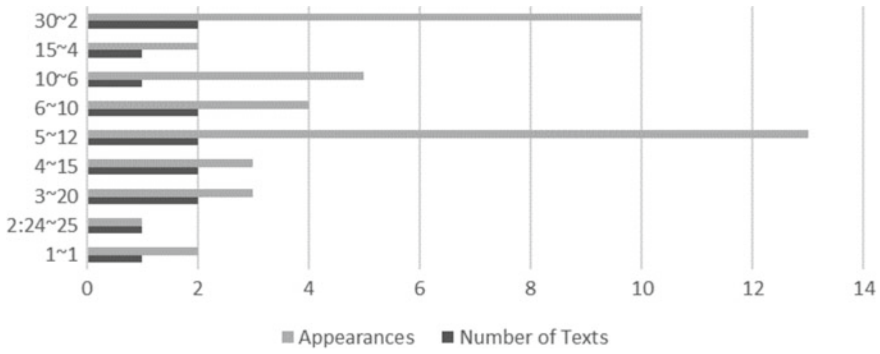

Chart 6 Wage rate distribution by reciprocal pair

Appendix 5
Discrepancy Index

5.A General Discrepancy Index

In this section all discrepancies are studied.

5.A.a Discrepancy by Text

Here discrepancies are organized by text and then line.

Text	Line	Per cent difference	Discrepancy type	Direction	Amount	Placement	Provenance
Ashm 1923-315	22	3.2	Uncertain	Down?	1 *bariga* 4 *ban* 9 2/3 *sila*	Total	Uncertain
YBC 04224	31, 32	11.8	Mistake	Down	1 *gu*	Total	Larsa or Larsa area
YBC 04224	35, 36a	0.003	Mistake	Down	One-6th *gin*	Remainder	Larsa or Larsa area
YBC 04224	35, 36b	5.1	Mistake	Up	4 5/6 mana 8 2/3 gin	Remainder	Larsa or Larsa area
YBC 04224	26	0.02	Rounding	Truncation	7 *sila*	Total	Larsa or Larsa area
NBC 05474	8	0.34	Rounding	Down	One-6th *sar*	Total	Larsa or Larsa area
NBC 06339	17, 18	0.034	Rounding	Truncation	7 (bricks)	Total	Larsa or Larsa area

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R. Middeke-Conlin, *The Making of a Scribe*, Why the Sciences of the Ancient World Matter 4, https://doi.org/10.1007/978-3-030-35951-5

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Text	Line	Per cent difference	Discrepancy type	Direction	Amount	Placement	Provenance
NBC 06339	17, 18	9.57	Uncertain	Down?	9 (men)	Total	Larsa or Larsa area
NBC 08014	1–3	0.457	Rounding	Up	3 *še*	In-kind value	Perhaps Larsa
YBC 05586	38	2.76	Measurement	Down	1 *gur* 3 *bariga* 1 *ban* 6 *sila*	Difference stated	Larsa
YBC 08758	11	2.22	Rounding	Truncation	One-4th *gin*	Total	Larsa
YBC 07473	13, 14	NA	Rounding	Up	NA	In-silver value	*Zarbilum*
AO 08464	31a	0.03	Uncertain	Truncation	22 *še*	Total	*Zarbilum*
Ashm 1922-281	Col 1 line 24	0.56	Uncertain	Down	6 (men)	Subtotal	Perhaps Larsa
Ashm 1922-281	Col 1 line 32	0.18	Mistake	Up	1 (men)	Total	perhaps Larsa
Ashm 1922-281	Col 2 line 32	0.14	Rounding	Truncation	1 *ban*	Total	perhaps Larsa
AO 06760	49–51	0.9	Mistake	Down	1 one-6th *gin*	In-silver value	Larsa
AO 06760	59	0.7	Mistake	Down	3 *gin*	Total	Larsa
AO 06760	61	0.002	Mistake	Down	1 *še*	Excess	Larsa
YBC 07310	10	0.57	Measurement	Down	3 *gur* 2 *bariga* 1 *ban*	Difference stated	Larsa
YBC 07187	17	1.28	Measurement	Down	7 *gur* 3 *bariga* 4 *ban*	Difference stated	Larsa
YBC 05494	12a	0.11	Rounding	Up	4 *sila*	Difference	Larsa
YBC 05494	12b	2.07	Measurement	Down	11 *gur* 4 *bariga*	difference stated	Larsa
Riftin 1937: no. 051	11	2.56	Measurement	Down	6 *gur* 4 *ban*	Difference stated	Larsa
YBC 06985	13	0.47	Measurement	Down	2 *gur* 1 *bariga*	Difference stated	Larsa
YBC 06663	11	0.36	Measurement	Down	4 *bariga* 3 *ban* 6 *sila*	Difference stated	Larsa
YBC 07194	15	5.44?	Measurement	Down	13 *gur* 1 *ban* 8 *sila*	Difference stated	Larsa
YBC 07194	13	0.08	Mistake	Up	1 *bariga*	Total then remainder	Larsa

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Text	Line	Per cent difference	Discrepancy type	Direction	Amount	Placement	Provenance
YBC 05580	12	0.13	Measurement	Down	4 *bariga*	Difference stated	Larsa
YBC 06231	14	0.86	Measurement	Down	6 *gur* 1 *bariga*	Difference stated	Larsa
YBC 07195	34	82.64	Mistake	Down	20 *gur*	Remainder	Larsa
AO 06763	13	0.5	Measurement	Down	3 *gur*	Difference stated	Larsa
Riftin 1937: no. 054	15	0.38	Measurement	Down	3 *bariga* 2 *ban* 4 *sila*	Difference stated	Larsa
AO 07034	38	0.19	Rounding	Down	11 *še*	Total	Larsa
YBC 08774	11	1.67	Measurement	Down	7 *gur* 6 *sila*	Difference stated	Larsa
YBC 05768	5	2.86	Mistake	Up	1 *bariga*	Total	Larsa
YBC 06216	12	3.85	Uncertain	up	2 *gur* 1 *bariga*	Total	Uncertain
Ashm 1932-378	9	0.002–0.0002	Rounding	Truncation	5 *še* - 19 *gin* 5 *še*	Subtotal	Uncertain
YBC 07183	19	0.43	Rounding	Truncation	1/3 *sila*	Total	Uncertain
Riftin 1937: no. 114	Col 4 line 3	0.03	Mistake	Up	1/3 *sila*	Entry	Uncertain, southern area
LB 1072	21	1.7	Rounding	Up	1/2 *sila*	Remainder	Perhaps near Isin
LB 1074	8	4.8	Mistake	Up	1 *bariga*	Subtotal	Uncertain
LB 1069	7, 8	2.41	Rounding	Up	2 (men)	Total	Uncertain
NBC 06763	10a	0.0018	Rounding	Truncation	2/3 *sar* 6 *gin* one-4th *gin*	Subtotal	Perhaps Larsa
NBC 06763	10b	0.24	Mistake	Up	10 *sar*	Subtotal	Perhaps Larsa
LB 1075	3	0.16	Rounding	Truncation	1/3 *sila*	Change rate calculation	Perhaps Larsa or north
AO 08524	3, 11	1.064	Rounding	Up	1 *sila*	Total	Larsa
AO 08493	9	5	Measurement	Down	2 *ban*	Difference not stated	Larsa
AO 08461	24	10	Rounding	Up	3 *sila*	Rate	Larsa
LB 3051	6a	9.3	Mistake	up	2 *ban*	Subtotal	Uncertain
LB 3051	6a	0.38	Rounding	Truncation	5 *gin*	Subtotal	Uncertain

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Text	Line	Per cent difference	Discrepancy type	Direction	Amount	Placement	Provenance
Ashm 1923-311	28’	0.0001	Rounding	Down	One-6th *sila*	Total	Uncertain
Ashm 1923-340	Col 7, line 12	2.22	Mistake	Down	1 *ban*	Yield calculation	Ur or Larsa
Ashm 1923-340	21, 22, col 3	0.01	Rounding	Up	1 *ban*	Total	Ur or Larsa
Ashm 1923-340	Col 7, line 21, 22	5.82	Mistake	Down	2 *gur*	Total	Ur or Larsa
Ashm 1923-298	4	6.54	Mistake	Up	1 *gur*	Total	Uncertain
YBC 04470	9	49.69	Mistake	Down	1 sixties *gur*	Subtotal	Larsa
YBC 04470	15	6.53	Mistake	Down	10 *gur*	Total	Larsa
Ashm 1922-290	10’	0.006	Rounding	Truncation	1/2 *sar* 5 *gin*	Total	Perhaps Larsa
Ashm 1922-290	Col 4 and 6 line 13	0.038	Rounding	Truncation	5/6 *sar*	Total	Perhaps Larsa

5.A.b Discrepancy by Type and Per cent

In this table discrepancies are divided by the type oferror whether a measurement inconsistency, mistake or rounding and then the per cent difference.

Measurement inconsistency						
Text	Line	Per cent difference	Discrepancy type	Direction	Amount	Placement
YBC 05580	12	0.13	Measurement	Down	4 *bariga*	Difference stated
YBC 06663	11	0.36	Measurement	Down	4 *bariga* 3 *ban* 6 *sila*	Difference stated
Riftin 1937: no. 054	15	0.38	Measurement	Down	3 *bariga* 2 *ban* 4 *sila*	Difference stated
YBC 06985	13	0.47	Measurement	Down	2 *gur* 1 *bariga*	Difference stated
AO 06763	13	0.5	Measurement	Down	3 *gur*	Difference stated
YBC 07310	10	0.57	Measurement	Down	3 *gur* 2 *bariga* 1 *ban*	Difference stated

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Measurement inconsistency						
Text	Line	Per cent difference	Discrepancy type	Direction	Amount	Placement
YBC 06231	14	0.86	Measurement	Down	6 *gur* 1 *bariga*	Difference stated
YBC 07187	17	1.28	Measurement	Down	7 *gur* 3 *bariga* 4 *ban*	Difference stated
YBC 08774	11	1.67	Measurement	Down	7 *gur* 6 *sila*	Difference stated
YBC 05494	12b	2.07	Measurement	Down	11 *gur* 4 *bariga*	Difference stated
Riftin 1937: no. 051	11	2.56	Measurement	Down	6 *gur* 4 *ban*	Difference stated
YBC 05586	38	2.76	Measurement	Down	1 *gur* 3 *bariga* 1 *ban* 6 *sila*	Difference stated
AO 08493	9	5	Measurement	Down	2 *ban*	Difference not stated
YBC 07194	15	5.44?	Measurement	Down	13 *gur* 1 *ban* 8 *sila*	Difference stated
Mistake						
AO 06760	61	0.002	Mistake	Down	1 *še*	Excess
YBC 04224	35, 36a	0.003	Mistake	Down	One-6th *gin*	Remainder
AO 06760	59	0.7	Mistake	Down	3 *gin*	Total
AO 06760	49–51	0.9	Mistake	Down	1 one-6th *gin*	In-silver value
Ashm 1923-340	Col 7, line 12	2.22	Mistake	Down	1 *ban*	Yield calculation
Ashm 1923-340	Col 7, line 21, 22	5.82	Mistake	Down	2 *gur*	Total
YBC 04470	15	6.53	Mistake	Down	10 *gur*	Total
YBC 04224	31, 32	11.8	Mistake	Down	1 *gu*	Total
YBC 04470	9	49.69	Mistake	Down	1 sixties *gur*	Subtotal
YBC 07195	34	82.64	Mistake	Down	20 *gur*	Remainder
Riftin 1937: no. 114	Col 4 line 3	0.03	Mistake	Up	1/3 *sila*	Entry
YBC 07194	13	0.08	Mistake	Up	1 *bariga*	Total then remainder

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Measurement inconsistency						
Text	Line	Per cent difference	Discrepancy type	Direction	Amount	Placement
Ashm 1922-281	Col 1 line 32	0.18	Mistake	Up	1(men)	Total
NBC 06763	10b	0.24	mistake	Up	10 *sar*	Subtotal
YBC 05768	5	2.86	Mistake	Up	1 *bariga*	Total
LB 1074	8	4.8	Mistake	Up	1 *bariga*	Subtotal
YBC 04224	35, 36b	5.1	Mistake	Up	4 5/6 mana 8 2/3 gin	Remainder
Ashm 1923-298	4	6.54	Mistake	Up	1 *gur*	Total
LB 3051	6a	9.3	Mistake	Up	2 *ban*	Subtotal
Rounding						
Ashm 1932-378	9	0.002, 0.0002	Rounding	Truncation	5 *še* - 19 *gin* 5 *še*	Subtotal
Ashm 1922-290	10’	0.006	Rounding	Truncation	1/2 *sar* 5 *gin*	Total
YBC 06763	10a	0.0018	Rounding	Truncation	2/3 *sar* 6 *gin* one-4th *gin*	Subtotal
YBC 04224	26	0.02	Rounding	Truncation	7 *sila*	Total
NBC 06339	17, 18	0.034	Rounding	Truncation	7 (bricks)	Total
Ashm 1922-290	Col 4 and 6 line 13	0.038	Rounding	Truncation	5/6 *sar*	Total
Ashm 1922-281	Col 2 line 32	0.14	Rounding	Truncation	1 *ban*	Total
LB 1075	3	0.16	Rounding	Truncation	1/3 *sila*	Change rate calculation
YBC 07183	19	0.43	Rounding	Truncation	1/3 *sila*	Total
LB 3051	6a	0.38	Rounding	Truncation	5 *gin*	Subtotal
YBC 08758	11	2.22	Rounding	Truncation	one-4th *gin*	Total
Ashm 1923-311	28’	0.0001	Rounding	Down	one-6th *sila*	Total
AO 07034	38	0.19	Rounding	Down	11 *še*	Total
NBC 05474	8	0.34	Rounding	Down	One-6th *sar*	Total
Ashm 1923-340	21, 22, col 3	0.01	Rounding	Up	1 *ban*	Total

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Measurement inconsistency						
Text	Line	Per cent difference	Discrepancy type	Direction	Amount	Placement
YBC 05494	12a	0.11	Rounding	Up	4 *sila*	Difference
NBC 08014	1, 3	0.457	Rounding	Up	3 *še*	In-kind value
AO 08524	3, 11	1.064	Rounding	Up	1 *sila*	Total
LB 1072	21	1.7	Rounding	Up	1/2 *sila*	Remainder
LB 1069	7, 8	2.41	Rounding	Up	2 (men)	Total
AO 08461	24	10	Rounding	Up	3 *sila*	Rate
YBC 07473	13, 14	NA	Rounding	Up	NA	In-silver value
YBC 06216	12	3.85	Uncertain	Up	2 *gur* 1 *bariga*	Total
AO 08464	31a	0.03	Uncertain	Truncation	22 *še*	Total
Ashm 1922-281	Col 1 line 24	0.56	Uncertain	Down	6 (men)	Subtotal
Ashm 1923-315	22	3.2	Uncertain	Down?	1 *bariga* 4 *ban* 9 2/3 *sila*	Total
NBC 06339	17, 18	9.57	Uncertain	Down?	9 (men)	Total

5.B Rounding

In this section rounding is isolated and then arranged by various aspects surrounding it.

5.B.a Rounding by Scribe

In this table, rounding is ordered by the scribe who carried it out.

Text	Line	Per cent difference	Direction	Amount	Placement	Scribe
YBC 04224	26	0.02	Truncation	7 *sila*	Total	Scribe A
NBC 05474	8	0.34	Down	One-6th *sar*	Total	Bureau of irrigation and excavation, *Lu-igisa*

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Text	Line	Per cent difference	Direction	Amount	Placement	Scribe
NBC 06339	17, 18	0.034	Truncation	7 (bricks)	Total	Bureau of irrigation and excavation, *Lu-igisa*
NBC 08014	1–3	0.457	Up	3 *še*	In-kind value	*Ilšu-ibbišu*
YBC 08758	11	2.22	Truncation	One-4th *gin*	Total	*Gimillum*
YBC 07473	13, 14	NA	Up	NA	In-silver value	*Itti-Sîn-milki*
Ashm 1922-281	Col 2 line 32	0.14	Truncation	1 *ban*	Total	Bureau of irrigation and excavation, *Nabi-Šamaš* A
YBC 05494	12a	0.11	Up	4 *sila*	Difference	Grain storage bureau – Uncertain Scribes
AO 07034	38	0.19	Down	11 *še*	Total	Grain storage bureau, *Sîn-māgir*A
Ashm 1932-378	9	0.002–0.0002	Truncation	5 *še* - 19 *gin* 5 *še*	Subtotal	*Šēp-Sîn* A
YBC 07183	19	0.43	Truncation	1/3 *sila*	Total	Scribe H
LB 1072	21	1.7	Up	1/2 *sila*	Remainder	Scribe J
LB 1069	7, 8	2.41	Up	2 (men)	Total	Grain harvest archive, scribe M
YBC 06763	10a	0.0018	Truncation	2/3 *sar* 6 *gin* one-4th *gin*	Subtotal	Bureau of irrigation and excavation, *Immer-ilī*
LB 1075	3	0.16	Truncation	1/3 *sila*	Change rate calculation	*Sîn-idinnam*
AO 08524	3, 11	1.064	Up	1 *sila*	Total	*Sîn-rāmā*
AO 08461	24	10	Up	3 *sila*	Rate	Scribe N
LB 3051	6a	0.38	Truncation	5 *gin*	Subtotal	*Aḫūšunu*
Ashm 1923-311	28’	0.0001	Down	One-6th *sila*	Total	Grain production archive, scribe O
Ashm 1923-340	21, 22, col 3	0.01	Up	1 *ban*	Total	Grain production archive, scribe P
Ashm 1922-290	10’	0.006	Truncation	1/2 *sar* 5 *gin*	Total	Bureau of irrigation and excavation, scribe R
Ashm 1922-290	Col 4 and 6 line 13	0.038	Truncation	5/6 *sar*	Total	Bureau of irrigation and excavation, scribe R

5.B.b Rounding by Provenance

Here rounding is ordered by the place, i.e. the scribal center, in which each document was located or the proposed location where the author of the document was educated.

Text	Line	Per cent difference	Direction	Amount	Placement	Provenance
YBC 05494	12a	0.11	Up	4 *sila*	Difference	Larsa
AO 07034	38	0.19	Down	11 *še*	Total	Larsa
AO 08524	3, 11	1.064	Up	1 *sila*	Total	Larsa
YBC 08758	11	2.22	Truncation	One-4th *gin*	Total	Larsa
AO 08461	24	10	Up	3 *sila*	Rate	Larsa or Larsa area
YBC 04224	26	0.02	Truncation	7 *sila*	Total	Larsa or Larsa area
NBC 06339	17, 18	0.034	Truncation	7 (bricks)	Total	Larsa or Larsa area
NBC 05474	8	0.34	down	One-6th *sar*	Total	Larsa or Larsa area
NBC 08014	1–3	0.457	up	3 *še*	In-kind value	Larsa or Larsa area
YBC 06763	10a	0.0018	Truncation	2/3 *sar* 6 *gin* one-4th *gin*	Subtotal	Perhaps Larsa
Ashm 1922-290	10’	0.006	Truncation	1/2 *sar* 5 *gin*	Total	Perhaps Larsa
Ashm 1922-290	Col 4 and 6 line 13	0.038	Truncation	5/6 *sar*	Total	Perhaps Larsa
Ashm 1922-281	Col 2 line 32	0.14	Truncation	1 *ban*	Total	Perhaps Larsa
LB 1075	3	0.16	Truncation	1/3 *sila*	Change rate calculation	Perhaps Larsa or north
LB 1072	21	1.7	Up	1/2 *sila*	Remainder	Perhaps near Isin
Ashm 1923-340	21, 22, col 3	0.01	Up	1 *ban*	Total	Ur or Larsa
YBC 07473	13, 14	NA	Up	NA	In-silver value	*Zarbilum*

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Text	Line	Per cent difference	Direction	Amount	Placement	Provenance
Ashm 1932-378	9	0.002–0.0002	Truncation	5 *še* - 19 *gin* 5 *še*	Subtotal	Uncertain
LB 3051	6a	0.38	Truncation	5 *gin*	Subtotal	Uncertain
Ashm 1923-311	28’	0.0001	Down	One-6th *sila*	Total	Uncertain
YBC 07183	19	0.43	Truncation	1/3 *sila*	Total	Uncertain
LB 1069	7, 8	2.41	Up	2 (men)	Total	Uncertain

5.B.c Rounding by Year

The following table lists the year date in which the document a rounded value appears on was produced.

Text	Line	Per cent difference	Direction	Amount	Placement	Date
Ashm 1922-290	10’	0.006	Truncation	1/2 *sar* 5 *gin*	Total	No date
Ashm 1922-290	Col 4 and 6 line 13	0.038	Truncation	5/6 *sar*	Total	No date
YBC 04224	26	0.02	Truncation	7 *sila*	Total	*Gungunum* of Larsa?
NBC 05474	8	0.34	down	One-6th *sar*	Total	*Sūmû-el* of Larsa year 16
NBC 06339	17, 18	0.034	Truncation	7 (bricks)	Total	*Sūmû-el* of Larsa year 16
NBC 08014	1–3	0.457	up	3 *še*	In-kind value	*Sîn-Iddinam* of Larsa year 06
Ashm 1922-281	Col 2 line 32	0.14	Truncation	1 *ban*	Total	*Rīm-Sîn* of Larsa year 01
YBC 07473	13, 14	NA	Up	NA	In-silver value	*Rīm-Sîn* of Larsa year 04
YBC 05494	12a	0.11	Up	4 *sila*	Difference	*Rīm-Sîn* of Larsa year 06
YBC 08758	11	2.22	Truncation	One-4th *gin*	Total	*Rīm-Sîn* of Larsa year 07
AO 07034	38	0.19	Down	11 *še*	Total	*Rīm-Sîn* of Larsa year 14
Ashm 1932-378	9	0.002–0.0002	Truncation	5 *še* - 19 *gin* 5 *še*	Subtotal	*Rīm-Sîn* of Larsa year 21
YBC 07183	19	0.43	Truncation	1/3 *sila*	Total	*Rīm-Sîn* of Larsa year 29

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Text	Line	Per cent difference	Direction	Amount	Placement	Date
LB 1072	21	1.7	up	1/2 *sila*	Remainder	*Rīm-Sîn* of Larsa year 31
YBC 06763	10a	0.0018	Truncation	2/3 *sar* 6 *gin* one-4th *gin*	Subtotal	*Rīm-Sîn* of Larsa year 38
LB 1069	7, 8	2.41	Up	2 (men)	Total	*Rīm-Sîn* of Larsa year 38
LB 1075	3	0.16	Truncation	1/3 *sila*	Change rate calculation	*Rīm-Sîn* of Larsa year 39
AO 08524	3, 11	1.064	up	1 *sila*	Total	*Rīm-Sîn* of Larsa year 50
AO 08461	24	10	Up	3 *sila*	Rate	*Rīm-Sîn* of Larsa year 57 or 58
LB 3051	6a	0.38	Truncation	5 *gin*	Subtotal	*Rīm-Sîn* of Larsa year 59
Ashm 1923-311	28’	0.0001	Down	One-6th *sila*	Total	*Hammu-rābi* of Babylon Year 32
Ashm 1923-340	21, 22, col 3	0.01	Up	1 *ban*	Total	*Hammu-rābi* of Babylon year 35

5.B.d Rounding by Administration Type

Here arrangement is by administration type.

Text	Line	Per cent difference	Direction	Amount	Placement	Administrative type
YBC 06763	10a	0.0018	Truncation	2/3 *sar* 6 *gin* one-4th *gin*	Subtotal	Bureau administrator
NBC 08014	1–3	0.457	Up	3 *še*	In-kind value	Bureau administrator
LB 1075	3	0.16	Truncation	1/3 *sila*	Change rate calculation	Bureau administrator
Ashm 1923-340	21, 22, col 3	0.01	Up	1 *ban*	Total	Bureau administrator
Ashm 1923-311	28’	0.0001	Down	One-6th *sila*	Total	Bureau administrator
Ashm 1922-290	10’	0.006	Truncation	1/2 *sar* 5 *gin*	Total	Bureau administrator
Ashm 1922-290	Col 4 and 6 line 13	0.038	Truncation	5/6 *sar*	Total	Bureau administrator
NBC 06339	17, 18	0.034	Truncation	7 (bricks)	Total	Bureau administrator

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Text	Line	Per cent difference	Direction	Amount	Placement	Administrative type
Ashm 1922-281	Col 2 line 32	0.14	Truncation	1 *ban*	Total	Bureau administrator
NBC 05474	8	0.34	Down	One-6th *sar*	Total	Bureau administrator
AO 08461	24	10	Up	3 *sila*	Rate	Personal
LB 1072	21	1.7	Up	1/2 *sila*	Remainder	Personal
LB 1069	7, 8	2.41	Up	2 (men)	Total	Personal
LB 3051	6a	0.38	Truncation	5 *gin*	Subtotal	Personal
AO 08524	3, 11	1.064	Up	1 *sila*	Total	Personal
YBC 07183	19	0.43	Truncation	1/3 *sila*	Total	Personal
YBC 05494	12a	0.11	Up	4 *sila*	Difference	Merchant
YBC 07473	13, 14	NA	Up	NA	In-silver value	Merchant
Ashm 1932-378	9	0.002–0.0002	Truncation	5 *še* - 19 *gin* 5 *še*	Subtotal	Merchant
YBC 08758	11	2.22	Truncation	One-4th *gin*	Total	Merchant
YBC 04224	26	0.02	Truncation	7 *sila*	Total	Merchant
AO 07034	38	0.19	Down	11 *še*	Total	Merchant

5.B.e Rounding by Placement in Text

In the following table arrangement is by where a rounded value appears in a text.

Text	Line	Per cent difference	Direction	Amount	Account type	Placement
YBC 05494	12a	0.11	Up	4 *sila*	Balanced grain delivery	Difference
NBC 08014	1–3	0.457	Up	3 *še*	Single transaction	In-kind value
YBC 07473	13, 14	NA	Up	NA	Balanced Silver account	In-silver value
AO 08461	24	10	Up	3 *sila*	List	Rate

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Text	Line	Per cent difference	Direction	Amount	Account type	Placement
LB 1072	21	1.7	Up	1/2 *sila*	List	Remainder
LB 1075	3	0.16	Truncation	1/3 *sila*	Tabular balanced account	Change rate calculation
Ashm 1932-378	9	0.002–0.0002	Truncation	5 *še* - 19 *gin* 5 *še*	List	Subtotal
YBC 06763	10a	0.0018	Truncation	2/3 *sar* 6 *gin* one-4th *gin*	Tabular list	Subtotal
LB 3051	6a	0.38	Truncation	5 *gin*	Balanced grain account	Subtotal
YBC 04224	26	0.02	Truncation	7 *sila*	Balanced silver account	Total
AO 07034	38	0.19	Down	11 *še*	Balanced grain account	Total
Ashm 1923-311	28’	0.0001	Down	One-6th *sila*	List	Total
NBC 06339	17, 18	0.034	Truncation	7 (bricks)	List	Total
NBC 05474	8	0.34	Down	One-6th *sar*	List	Total
YBC 07183	19	0.43	Truncation	1/3 *sila*	List	Total
AO 08524	3, 11	1.064	Up	1 *sila*	List	Total
YBC 08758	11	2.22	Truncation	One-4th *gin*	List	Total
LB 1069	7, 8	2.41	Up	2 (men)	List	Total
Ashm 1922-290	10’	0.006	Truncation	1/2 *sar* 5 *gin*	Tabular list	Total
Ashm 1922-290	Col 4 and 6 line 13	0.038	Truncation	5/6 *sar*	Tabular list	Total
Ashm 1922-281	Col 2 line 32	0.14	Truncation	1 *ban*	Tabular list	Total
Ashm 1923-340	21, 22, col 3	0.01	Up	1 *ban*	Tabular list	Total

Bibliography

Adams, Robert McC, and Hans J. Nissen. 1972. *The Uruk countryside: The natural setting of urban societies*. Chicago, London: The University of Chicago Press.

Alexander, John B. 1943. Early Babylonian letters and economic texts. In *Babylonian inscriptions in the collection of James B. Nies* 7. New Haven, London: H. Milford, Oxford University Press.

Al-Rawi, Farouk N.H., and Jöran Friberg. 2016. New mathematical cuneiform texts. In *Sources and studies in the history of mathematics and physical sciences*. Cham: Springer.

Allchin, Douglas. 2001. Error types. *Perspectives on Science* 9: 38–58.

Anbar, Moshé. 1975. Textes de l'époque babylonienne ancienne. *Revue d'Assyriologie et d'Archéologie Orientale* 69: 109–136.

Anbar, Moshé. 1978. Textes de l'époque babylonienne ancienne II: Les archives de Sep-Sin. *Revue d'Assyriologie et d'Archéologie Orientale* 72: 113–138.

Arnaud, Daniel. 1976. TCL X et XI: ajouts et corrections. *Revue d'Assyriologie et d'Archéologie Orientale* 70: 84–92.

Arnaud, Daniel. 1978. French archaeological mission in Iraq. A catalogue of the cuneiform tablets and inscribed objects found during the 6th season in Tell Senkereh, Larsa. *Sumer* 34: 165–178.

Arnaud, Daniel. 1994. Texte aus Larsa: die epigraphischen Funde der 1. Kampagne in Senkereh-Larsa, 1933. In *Berliner Beiträge zum Vorderen Orient,* vol. 3. Berlin: Reimer.

Arnaud, Daniel, Yves Calvet, and Jean-Louis Huot. 1979. Ilšu-Ibnišu, orfèvre de l'E.Babbar de Larsa. La jarre L.76.77 et son contenu. *Syria* 56: 1–64.

Asper, Markus. 2012. 'True' and 'false' errors in ancient (Greek) computation. In *Productive errors: Scientific concepts in antiquity*, ed. Klaus Geus and Mark J. Geller, 47–66. Berlin: Max-Planck-Institut für Wissenschaftsgeschichte.

Beaugeard, Anne-Claude. 2010. Les textiles du Moyen-Euphrate à l'époque paléo-babylonienne d'après un ouvrage récent. In *Textile terminologies in the Ancient Near East and Mediterranean from the third to the first millennia BC*, ed. Marie-Louise Nosch and Cécile Michel, 283–289. Oxford, Oakville, CA: Oxbow Books.

Biggs, Robert D., and John Nicholas Postgate. 1978. Inscriptions from Abu Salabikh, 1975. *Iraq* 40: 101–118.

Black, Jeremy, Andrew George, and Nicholas Postgate. 2000. *A concise dictionary of Akkadian*. In *SANTAG* 5, 2nd ed. Wiesbaden: Harrassowitz Verlag.

Breckwoldt, Tina. 1994. *Economic mechanisms in Old Babylonian Larsa*. Ph.D. diss., Cambridge University.

Breckwoldt, Tina. 1995/1996. Management of grain storage in Old Babylonian Larsa. *Archiv für Orientforschung* 42/43: 64–88.

R. Middeke-Conlin, *The Making of a Scribe*, Why the Sciences of the Ancient World Matter 4, https://doi.org/10.1007/978-3-030-35951-5

Bruins, Evert. 1970. La construction de la grande table de valeurs réciproques AO 6456. In *Actes de la XVIIe Rencontre Assyriologique Internationale—Publications du comité belge de recherches historiques, épigraphiques et archéologiques en Mésopotamie*, ed. A. Finet, 99–118. Ham-sur-Heure: Comité Belge de Recherches en Mésopotamie.

Brunke, Hagan. 2011. Essen in Sumer: Metrologie, Herstellung und Terminologie nach Zeugnis der Ur III-zeitlichen Wirtschaftsurkunden. In *Geschichtswissenschaften*, vol. 26. Munich: Herbert Utz Verlag.

Brunke, Hagan. 2012. On Mesopotamian measure theory. In *Productive errors: Scientific concepts in antiquity*, ed. Klaus Geus and Mark J. Geller, 9–22. Berlin: Max-Planck-Institut für Wissenschaftsgeschichte.

Calvert, Yves, Dominique Charpin, Serge Cleuziou, et al. 1976. Larsa, rapport préliminaire sur la sixième campagne de fouilles. *Syria* 53: 1–45.

Chambon, Grégory, and Lionel Marti. 2017. Capacity measures in context I: La question des conversions. *Revue d'Assyriologie et d'Archéologie Orientale* 111: 65–86.

Chambon, Grégory, and Eleanor Robson. 2011. Untouchable or unrepeatable? The upper end of the old Babylonian metrological systems for capacity and area. *IRAQ* 73: 127–147.

Charles, Michael P. 1984. Introductory remarks on the cereals. *Bulletin of Sumerian Agriculture* 1: 17–31.

Charpin, Dominique. 1979. *Early Old Babylonian documents, in memory of Albrecht Goetze and Ferris J. Stephens*. *Bibliotheca Orientalis*, vol. 36, ed. S. Simmons, 188–200.

Charpin, Dominique. 1980. *Archives familiales et propriété privée en Babylonie ancienne: Étude des documents de "Tell Sifr"*. Geneva: Droz.

Charpin, Dominique. 1982. Marchands du palais et marchands du temple à la fin de la I^re^ dynastie de Babylone. *Journal Asiatique* 270: 25–65.

Charpin, Dominique. 1986. *Le clergé d'Ur au siècle d'Hammurabi*. Geneva: Droz.

Charpin, Dominique. 2000. La ville d'Ur au XVIIIe siècle av. J.-C. In *Les routes du Proche-Orient. Des séjours d'Abraham aux caravanes de l'encens*, ed. André Lemaire, 33–40. Paris: Desclée de Brouwer Editions.

Charpin, Dominique. 2003. *Hammu-rabi de Babylone*. Paris: Presses Universitaires de France.

Charpin, Dominique. 2003. La politique immobilière des marchands de Larsa à la lumière des découvertes épigraphiques de 1987 et 1989. In *Larsa, travaux de 1987 et 1989*, ed. Jean-louis Huot, 311–322. Beirut: Institut Français d'Archéologie du Proche-Orient.

Charpin, Dominique. 2004a. Lire et écrire en Mésopotamie: Une affaire de spécialistes? *Comptes rendus de l'Académie des Inscriptions et Belles Lettres* 148^e^*année*, 481–501.

Charpin, Dominique. 2004b. Tiel 1: Histoire politique du Proche-Orient Amorrite (2002-1595). In *Mesopotamien: Die altbabylonische Zeit*, eds. Dietz Otto Edzard, Dominique Charpin, and Marten Stol, 23–480. Freiburg and Göttingen: Universitätsverlag, Vandenhoeck and Ruprecht.

Civil, Miguel. 1995. Ancient mesopotamian lexicography. In *Civilizations of the ancient near east IV*, ed. J. Sasson, 2305–2314. New York: Charles Scribner's Sons.

Civil, Miguel. 2009. The Mesopotamian lexical lists: Authors and commentators. In *Reconstruyendo el pasado remoto. Estudios sobre el Próximo Oriente Antiguo en homenaje a Jorge R. Silva Castillo/reconstructing a distant past: Ancient Near Eastern essays in tribute to Jorge R. Silva Castillo*, eds. Diego A. Barreyra Fracaroli, and Gregorio Del Olmo Lete, 65–72. Sabadell and Barcelona: Editorial AUSA.

Civil, Miguel, Margaret W. Green, and Wilfred G. Lambert. 1979. Ea A = nâqu, Aa A = nâqu, with their forerunners and related texts. In *Materialien zum Sumerischen Lexikon*, vol. 14. Rome: Pontificio Instituto Biblico.

Clevenstine, Emmert. 2015. MAH 15886 + 16295, a Rim-Sin tabular account in Geneva. *Cuneiform Digital Library Notes* (009). https://cdli.ucla.edu/pubs/cdln/php/single.php?id=62. Accessed 17 Nov 2018.

Cohen, Yoram. 2009. The scribes and scholars of the city of Emar in the Late Bronze Age. In *Harvard semitic studies* 59. Winona Lakes, IN: Eisenbrauns.

Cripps, Eric. 2017. The structure of prices in the Neo-Sumerian economy (I): Barley: Silver price ratios. *Cuneiform Digital Library Journal* (002). https://cdli.ucla.edu/pubs/cdlj/2017/cdlj2017_002.html. Accessed 30 Jan 2018.

Cuneiform Digital Library Initiative. 2018. https://cdli.ucla.edu. Accessed 30 June 2018.

Dalley, Stephanie with copies contributed by Eleanor Robson, and Tina Breckwoldt. 2005. Old Babylonian texts in the Ashmolean Museum. In *Oxford editions of Cuneiform texts*, vol. 15. Oxford: Clarendon Press.

Damerow, Peter. 2012. Sumerian beer: The origins of brewing technology in Ancient Mesopotamia. *Cuneiform Digital Library Journal* (002). https://cdli.ucla.edu/pubs/cdlj/2012/cdlj2012_002.html. Accessed 10 Jan 2014.

Damerow, Peter, and Robert K. Englund. 1987. Kapitel 3, die Zahlzeichensystem der Archaischen Texten aus Uruk. In *Zeichenliste der Archaischen Texte aus Uruk II*, ed. Margaret W. Green and Hans J. Nissen, 117–166. Berlin: Gebrüder Mann.

De Graef, Katrie. 2002. An account of the redistribution of land to soldiers in late Old Babylonian Sippar-Amnānum. *Journal of the Economic and Social History of the Orient* 45: 141–178

Delnero, Paul. 2010. Sumerian extract tablets and scribal education. *Journal of Cuneiform Studies* 62: 53–70.

Delnero, Paul. 2012. Memorization and the transmission of Sumerian literary compositions. *Journal of Near Eastern Studies* 71: 189–208.

Dossin, George. 1933. Lettres de la première dynastie babylonienne. In *Musée du Louvre, Département des Antiquités Orientales, Textes Cunéiformes*, vol. 17. Paris: Paul Geuthner.

Dossin, George. 1934. Lettres de la première dynastie babylonienne. In *Musée du Louvre, Département des Antiquités Orientales, Textes Cunéiformes*, vol. 18. Paris: Paul Geuthner.

Durand, Jean-Marie. 1998. Les documents épistolaires du palais de Mari II. In *Littératures Anciennes du Proche-Orient*, vol. 17. Paris: Les Éditions du Cerf.

Edzard, Dietz Otto. 1987–1990. Mami-Sarrat. In *Reallexikon der Assyriologie und vorderasiatischen Archäologie* VII, vol. 329, eds. Dietz Otto Edzard, Erich Ebeling, and Bruno Meissner. Berlin, New York: Walter de Gruyter.

Edzard, Dietz Otto. 2003. Sumerian grammar. In *Handbuch der Orientalistik*, vol. 71. Leiden: Brill.

Edzard, Dietz Otto, and Gertrude Farber. 1974. Die Orts- und Gewässernamen der Zeit der 3. Dynastie von Ur. In *Répertoire géographique des textes cunéiformes*, vol. 2. Wiesbaden: Reichert.

Electronic Pennsylvania Sumerian Dictionary (ePSD). 2006. http://psd.museum.upenn.edu/nepsd-frame.html. Accessed 19 July 2016.

Englund, Robert K. 1998. Texts from the late Uruk period. In *Mesopotamien: Späturuk-Zeit und Frühdynastische Zeit*, eds. Robert K. Englund, Josef Bauer, and Manfred Krebernik, 15–233. Freiburg and Gottingen: Universitätsverlag, Vandenhoeck und Ruprecht.

Englund, Robert K. 2012. Chap. 21: Equivalency values and the command of the Ur III period in Mesopotamia. In *The construction of value in the ancient world*, eds. John K. Papadopoulos, and Gary Urton, 427–458. UCLA: Cotsen Institute of Archaeology.

Faust, David E. 1941. Contracts from Larsa, dated in the reign of Rim-Sin. In *Yale oriental series, Babylonian texts*, vol. 8. New Haven: Yale University Press.

Feigin, Samuel. 1979. Introduction and indices by A. Leo Oppenheim and assistance of Mark E. Cohen. Legal and administrative texts of the reign of Samsu-iluna. In *Yale oriental series, Babylonian texts*, vol. 12. New Haven: Yale University Press.

Feuerherm, Karljürgen. 2004. *Abum-Waqar and his circle: A prosopographic study,* 2 vols. Ph.D. dissertation, University of Toronto.

Fiette, Baptiste. 2018. Le palais, la terre et les hommes: la gestion du domaine royal de Larsa d'après les archives de Šamaš-Hazir. In *Archibab* 3. Antony, Hauts-de-Seine: Société pour l'Étude du Proche-Orient Ancien (SEPOA).

Figulla, Hugo H., and William J. Martin. 1953. Letters and documents of the Old-Babylonian period. In *Ur Excavations: Texts* 5. London, Philadelphia: Publications of the Joint Expedition of the British Museum and of the Museum of the University of Pennsylvania to Mesopotamia.

Fitzgerald, Madeleine. 2002. *The rulers of Larsa*. Ph.D. dissertation, Near Eastern Languages and Civilizations, Yale University.

Fleming, Daniel E. 1998. Mari and the possibilities of Biblical memory. *Revue d'Assyriologie et d'Archéologie Orientale* 92: 41–78.

Földi, Zsombor. 2014. On Old Babylonian Palastgeschäft in Larsa. The meaning of *sūtum* and the 'circulation' of silver in state/private business. In *Studies in economic and social history of the Ancient Near East in memory of Péter Vargyas*, eds. Zoltán Csabai, and Tibor Grüll, 79–117. Budapest: L'Harmattan.

Foster, Benjamin R. 1982. Archives and record-keeping in Sargonic Mesopotamia. *Zeitschrift für Assyriologie und Vorderasiatische Archäologie* 72: 1–27.

Foster, Benjamin R. 1982. Education of a bureaucrat in Sargonic Sumer. *Archiv für Orientforschung* 550: 238–241.

Fowler, David, and Eleanor Robson. 1998. Square root approximations in Old Babylonian mathematics: YBC 7289 in context. *Historia Mathematica* 25: 366–378.

Frayne, Douglas R. 1989. A struggle for water: A case study from the historical records of the cities Isin and Larsa (1900-1800 BC). *The Canadian Society for Mesopotamian Studies Bulletin* 17: 17–28.

Friberg, Jöran. 1981. Methods and traditions of Babylonian Mathematics, II: An Old Babylonian catalogue text with equations for squares and circles. *Journal of Cuneiform Studies* 33: 57–64.

Friberg, Jöran. 1993. On the structure of cuneiform metrological table texts from the—1st millennium. In *Die Rolle der Astronomie in Kulturen Mesopotamiens: Beiträge zum 3. Grazer Morgenländischen Symposion (23–27 Sept 1991). Grazer Morgenländische Studien*, vol. 3, ed. Hannes.D. Glater, 383–405. Graz: RM Druck-und Verlagsgesellschaft.

Friberg, Jöran. 2000. Mathematics at Ur in the Old Babylonian period. *Revue d'Assyriologie et d'Archéologie Orientale* 94: 97–188.

Friberg, Jöran. 2001. Bricks and mud in metro-mathematical cuneiform texts. In *Changing views on ancient Near Eastern Mathematics*, *Berliner Beiträge zum Vorderen Orient*, vol. 19, eds. Jens Høyrup, and Peter Damerow, 61–154. Berlin: Dietrich Reimer.

Friberg, Jöran. 2005. *Unexpected links between Egyptian and Babylonian mathematics*. Singapore: World Scientific Publishing Co.

Friberg, Jöran. 2007. A remarkable collection of Babylonian mathematical texts. In *Manuscripts in the Schøyen collection: Cuneiform texts* 1. New York: Springer.

Friberg, Jöran. 2009. A geometric algorithm with solutions to quadratic equations in a Sumerian juridical document from Ur III Umma. *Cuneiform Digital Library Journal* (003). https://cdli.ucla.edu/pubs/cdlj/2009/cdlj2009_003.html. Accessed 15 Aug 2013.

Friberg, Jöran, Hermann Hunger, and Farouk N.H. Al-Rawi. 1990. 'Seed and Reeds', a metro-mathematical topic text from late Babylonian Uruk. *Baghdader Mitteilungen* 21: 483–557.

Gadd, Cyril J., and Samuel N. Kramer. 1966. Literary and religious texts: Second part. In *Ur Excavations: Texts*, vol. 6. London, Philadelphia: Publications of the Joint Expedition of the British Museum and of the Museum of the University of Pennsylvania to Mesopotamia.

Gelb, Ignace J., Martha T. Roth et al. (eds.) 1956–2010. *The Assyrian dictionary of the Oriental Institute of the University of Chicago,* 21 vols. Chicago: Oriental Institute of the University of Chicago.

Geller, Mark J., and Klaus Geus. 2012. "Irrtum" fallacies in ancient sciences. In *Productive errors: Scientific concepts in antiquity*, ed. Klaus Geus and Mark J. Geller, 3–8. Berlin: Max-Planck-Institut für Wissenschaftsgeschichte.

George, Andrew R. 1993. *House most high: The temples of ancient Mesopotamia*. Winona Lake, IN: Eisenbrauns.

Goddeeris, Anne. 2002. *Economy and society in northern Babylonia in the early Old Babylonian period (ca. 2000–1800 BC)*. Leuven: Peeters.

Goddeeris, Anne, with contributions from U. Seidl. 2016. The Old Babylonian legal and administrative texts in the Hilprecht collection, Jena, 2 vols. In *Texte und Materialien der Hilprecht Collection*, vol. 10. Weisbaden: Harrassowitz Verlag.

Goetze, Albrecht. 1945. Chap. 4. The Akkadian dialects of the Old-Babylonian mathematical texts. In *Mathematical cuneiform texts. American Oriental Series*, vol. 29, eds. Otto Neugebauer, and Abraham J. Sachs, 146–151. New Haven: American Oriental Series and American Schools of Oriental Research.

Goetze, Albrecht. 1964. Remarks on the Old Babylonian Itinerary. *Journal of Cuneiform Studies* 18: 114–119.

Grice, Ettalene M. 1919. Records from Ur and Larsa dated in the Larsa dynasty. In *Yale oriental series, Babylonian texts* 5. New Haven: Yale University Press.

Groneberg, Brigitte. 1980. Die Orts- und Gewässernamen der altbabylonischen Zeit. In *Répertoire Géographique des Textes Cunéiformes*, vol. 3. Wiesbaden: Reichert.

Guichard, Michaël. 1997. Annexe:Compte de fourmis. *Mari* 8: 314–321.

Gurney, Oliver R. 1974. Middle Babylonian legal documents and other texts. In *Ur excavations: Texts*, vol. 7. London, Philadelphia: Publications of the Joint Expedition of the British Museum and of the Museum of the University of Pennsylvania to Mesopotamia.

Hafford, William B. 2005. Mesopotamian mensuration balance pan weights from Nippur. *Journal of the Economic and Social History of the Orient* 48: 345–387.

Hallo, William W. 2004. Bookkeeping in the 21st century BCE. In *Creating economic order: Record-keeping, standardization, and the development of accounting in the Ancient Near East*, ed. Michael Hudson and Cornelia Wunsch, 89–106. Bethesda, MD: CDL Press.

Halloran, John A. 2006. *Sumerian lexicon: A dictionary guide to the Ancient Sumerian language*. Los Angeles: Logogram publishing.

Harris, Rivkah. 1975. *Ancient Sippar: A demographic study of an Old Babylonian city (1894-1595)*. Leiden: Nederlands Historisch-Archaeologisch Instituut te Istanbul.

Heimpel, Wolfgang. 2009. Workers and construction work at Garsana. In *Cornell University studies in Assyriology and Sumerology*, vol. 5. Bethesda, MD: CDL Press.

Hilprecht, Hermann V. 1906. Mathematical, metrological, and chronological tablets from the temple library of Nippur. In *Series A: Cuneiform texts*, vol. 10, part 2. Philadelphia: Department of Archaeology, University of Pennsylvania.

Hon, Giora. 1989. Is there a concept of experimental error in Greek astronomy? *The British Journal for the History of Science* 22: 129–150.

Hon, Giora. 1995. Going wrong: To make a mistake, to fall into an error. *The Review of Metaphysics* 49: 3–20.

Høyrup, Jens. 2002. *Lengths, widths, surfaces: A portrait of Old Babylonian algebra and its kin*. New York: Springer.

Høyrup, Jens. 2007. The roles of Mesopotamian bronze age mathematics: Tool for state formation and administration—Carrier of teachers' professional intellectual autonomy. *Educational Studies in Mathematics* 66: 257–271.

Høyrup, Jens. 2011. Mesopotamian calculation: Background and contrast to Greek mathematics. Paper presented at the IX Congresso della società Italiana di storia della matematica, 12 Nov 2011, Genova.

Huber, Peter 1999/2000. Astronomical dating of Ur III and Akkad. *Archiv für Orientforschung* 46, 47: 50–79.

Huenergard, John. 2000. A grammar of Akkadian. In *Harvard semitic studies*, vol. 45. Winona Lake, IN: Eisenbrauns.

Hunger, Hermann. 2009. How uncertain is Mesopotamian chronology? In *Time's up! Dating the Minoan eruption of Santorini: Acts of the Minoan eruption chronology workshop, Sandbjerg Nov 2007*, ed. D.A. Warburton, 145–152. Athens, Aarhus: Danish Institute at Athens and Aarhus University Press.

Huot, Jean-Louis. 1983. Larsa et 'Oueili, travaux de 1978–1981. In *Mémoire*, vol. 26. Paris: Editions Recherche sur les Civilisations.

Huot, Jean-Louis. 1985. Travaux en basse Mésopotamie, les fouilles francaises à Larsa et 'Oueili. *Comptes Rendus des Séances de l'Académie des Inscriptions et Belles-Lettres* 25: 300–318.

Huot, Jean-Louis (ed.). 1987. *Larsa (10e campagne, 1983) et 'Oueili: rapport préliminaire*. Paris: Editions Recherche sur les Civilisations.

Huot, Jean-Louis. 1987. Larsa (excavation report). *Archiv für Orientforschung* 34: 111–115.

Huot, Jean-Louis (ed.). 1989. *Larsa: travaux de 1985*. Paris: Editions Recherche sur les Civilisations.

Huot, Jean-Louis, Luc Bachelot, Jean-Pierre Braun, et al. 1978. Larsa, rapport préliminaire sur la septième campagne à Larsa et la première campagne à Tell el 'Oueili (1976). *Syria* 55: 183–223.

Jean, Charles-François. 1926. Contrats de Larsa. Première série: planches I à XCXIX. In *Musée du Louvre, Département des Antiquités Orientales, Textes Cunéiformes*, vol. 10. Paris: Paul Geuthner.

Jean, Charles-François. 1931. *Larsa d'après les textes cunéiformes *2187 à *1901*. Paris: Paul Geuthner.

Jean, Charles-François. 1950. *Lettres diverses*. *Archives royales de Mari II*. Paris: Imprimerie Nationale.

Joannès, Francis. 1989. La culture matérielle à Mari (IV): les méthodes de pesée: à propos d'un ouvrage récent. *Revue d'Assyriologie et d'Archéologie Orientale* 83: 113–152.

Johnstone, Steven. 2011. *A history of trust in ancient Greece*. Chicago, London: University of Chicago Press.

Joint committee for guides in metrology. 2012. *International vocabulary of metrology—Basic and general concepts and associated terms*, 3rd edn. https://www.nist.gov/sites/default/files/documents/pml/div688/grp40/International-Vocabulary-of-Metrology.pdf. Accessed 16 Nov 2018.

Klengel, Horst. 1973. Altbabylonische Rechts- und Wirtschaftsurkunden. In *Vorderasiatische Schriftdenkmäler der Staatlichen Museen zu Berlin, n.F.* 2. Berlin: Akademie-Verlag.

Kozyreva, Nelly V. 1988. *Drevniaia Larsa: ocherki khoziaistvennoi zhizni*. Moscow: Nauka.

Koschaker, Paul. 1942. Zur staatlichen Wirtschaftsverwaltung in altbabylonischer Zeit, insbesondere nach Urkunden aus Larsa. *Zeitschrift für Assyriologie und Vorderasiatische Archäologie* 47: 135–180.

Krecher, Joachim. 1987. DU = ku$_x$(-r̂) "eintreten", " hineinbringen". *Zeitschrift für Assyriologie und Vorderasiatische Archäologie* 77: 7–21

Leemans, Wilhelmus F. 1950. *The Old-Babylonian merchant: His business and his social position*. Leiden: E.J. Brill.

Leemans, Wilhelmus F. 1954. Legal and economic records from the kingdom of Larsa. In *Studia ad tabulas cuneiformes collectas a F.M. Th. de Liagre Bohl pertinentia*, vol. 1, part 2. Leiden: E. J. Brill.

Leemans, Wilhelmus F. 1960. Foreign trade in the Old Babylonian period as revealed by texts from Southern Mesopotamia. In *Studia et Documenta ad Jura Orientis Antiqui Pertinentia*, vol. 6. Leiden: E.J. Brill.

Leemans, Wilhelmus F. 1964. Old Babylonian legal and administrative documents. In *Tabulae Cuneiformes a F. M. Th. de Liagre Böhl Collectae*, vol. 1. Leiden: Nederlands Instituut voor het Nabije Oosten.

Leemans, Wilhelmus F. 1976. Quelques remarques à propos d'un livre récent concernant la région d'Uruk/Warka, the Uruk Countryside: The natural setting of urban societies by Robert McC. Adams and Hans J. Nissen. *Journal of the Economic and Social History of the Orient* 19: 215–221.

Leick, Gwendolyn. 2002. *Mesopotamia: The invention of the city*. London: Penguin Press.

Llop, Jaume, and George Andrew R. 2001/2002. Die babylonisch-assyrischen Beziehungen und die innere Lage Assyriens in der Zeit der Auseinandersetzung zwischen Ninurta-tukulti-Aššur und Mutakkil-Nusku nach neuen keilschriftlichen Quellen. *Archiv für Orientforschung* 48/49: 1–23.

Loftus, William. 1857. *Travels and researches in Chaldœa and Susiana; with an account of excavations at Warka, the Erech of Nimrod, and Shúsh, Shushan the palace of Esther, in 1849–1852*. New York: Robert Carte and Company.

Margueron, Jean. 1970. Larsa, rapport préliminaire sur la quatrième campagne. *Syria* 47: 261–277.

Margueron, Jean. 1971. Larsa, rapport préliminaire sur la cinquième campagne. *Syria* 48: 271–287.

Mayo, Deborah. 1996. *Error and the growth of experimental knowledge*. Chicago: University of Chicago Press.

Mayo, Deborah. 2010. Learning from error: How experiment gets a life (of its own) (Draft). Paper presented in the workshop, error in the sciences, 24–28 Oct 2010. Leiden: The Lorentz Center.

McIntosh, J. 2005. *Ancient Mesopotamia: New Perspectives*. Santa Barbara: ABC-CLIO.

Mélès, Baptiste. 2013–2018. With the assistance of Christine Proust, contributions by Mathieu Ossendrijver and Bruno Gombert. *Mesocalc: A Mesopotamian Calculator*. http://baptiste.meles.free.fr/site/mesocalc.html. Accessed 30 June 2018.

Merriam-Webster. 2018. https://www.merriam-webster.com. Accessed 25 Oct 2018.

Michalowski, Piotr. 2012. Literacy, schooling and the transmission of knowledge in early Mesopotamian culture. In *Theory and practice of knowledge transfer. Studies in school education in the Ancient Near East and beyond*, eds. Wolfert S. Van Egmond, and Wilfred H. Van Soldt, 39–57. Leiden: Nederlands Instituut voor Het Nabije Oosten.

Michel, Cécile. 1990. Ebbûtum et ebbum, la culture matérielle à Mari. *MARI* 6: 181–218.

Michel, Cécile. Forthcoming. Weighing units and weights in the context of trade from upper Mesopotamia to Anatolia (nineteenth and eighteenth centuries BCE). In *Cultures of computation and quantification*, eds. Karine Chemla, Agathe Keller, and Christine Proust. Dordrecht: Springer.

Michel, Cécile, and Klaas R. Veenhof. 2010. The textiles traded by the Assyrians in Anatolia (19th-18th centuries BC). In *Textile terminologies in the Ancient Near East and Mediterranean from the third to the first millennia BC*, ed. Marie-Louise Nosch and Cécile Michel, 210–271. Oxford, Oakville, CA: Oxbow Books.

Middeke-Conlin, Robert. 2014. The scents of Larsa: A study of the aromatics industry in an Old Babylonian kingdom. *Cuneiform Digital Library Journal* (001). https://cdli.ucla.edu/pubs/cdlj/2014/cdlj2014_001.html. Accessed 30 Apr 2014.

Middeke-Conlin, Robert. 2018. Estimation and observation: A study of two Old Babylonian tabular administrative documents. In *Text and image. Proceedings of the 61e Rencontre Assyriologique Internationale, Geneva and Bern, 22–26 July 2015. Orbis Biblicus et Orientalis Series Archaeologica*, vol. 40, eds. Pascal Attinger, Antoine Cavigneaux, Catherine Mittermayer, and Mirko Novak, 281–291. Leuven: Peeters Publishers.

Middeke-Conlin, Robert. Forthcoming a. Connecting a disconnect: Applying the scribal education to a professional setting during the Old Babylonian period. In *Mathematics, administrative and economics activites in the ancient worlds*, eds. Cécile Michel, and Karine Chemla. Dordrecht: Springer.

Middeke-Conlin, Robert. Forthcoming b. *Old Babylonian texts dealing with area, volume, and bricks*. *Texts from the Babylonian collection*. New Haven: Yale University Press.

Middeke-Conlin, Robert. Forthcoming c. The *nazbalum* in the Old Babylonian period: A concrete number or administrative tool? In *Cultures of computation and quantification*, eds. Karine Chemla, Agathe Keller, and Christine Proust. Dordrecht: Springer.

Middeke-Conlin, Robert and Christine Proust. 2014. Interest, price, and profit: An overview of mathematical economics in YBC 4698. *Cuneiform Digital Library Journal* (003). https://cdli.ucla.edu/pubs/cdlj/2014/cdlj2014_003.html. Accessed 18 July 2014.

Muroi, Kazuo. 1990. Interest calculation of Babylonian mathematics: New interpretations of VAT 8521 and VAT 8528. *Historia Scientiarum* 39: 29–34.

Nemet-Nejat, Karen R. 1993. Cuneiform mathematical texts as a reflection of everyday life in Mesopotamia. In *American oriental series*, vol. 75. New Haven: American Oriental Society.

Nemet-Nejat, Karen R. 1995. Systems for learning mathematics in Mesopotamian scribal schools. *Journal of Near Eastern Studies* 54: 241–260.

Netz, Reviel. 2002. Counter culture: Towards a history of Greek numeracy. *History of Science* 40: 321–352.

Neugebauer, Otto. 1935–1937. Mathematische Keilschrift-Texte. In *Quellen und Studien zur Geschichte der Mathematik, Astronomie und Physik*, vol. 3. Berlin: Springer.

Neugebauer, Otto, and Abraham J. Sachs. 1945. Mathematical cuneiform texts. In *American oriental series*, vol. 29. New Haven: American Oriental Series and American Schools of Oriental Research.

Neugebauer, Otto, and Abraham J. Sachs. 1984. Mathematical and metrological texts. *Journal of Cuneiform Studies* 36: 243–251.

Nissen, Hans J., Peter Damerow, and Robert K. Englund. 1993. *Archaic bookkeeping. Writing and techniques of economic administration in the Ancient Near East*. Chicago: University of Chicago Press.

Oelsner, Joachim. 2001. HS 201—Eine Reziprokentabelle der Ur III-Zeit. In *Changing views on ancient near eastern Mathematics*, ed. Jens Høyrup and Peter Damerow, 53–60. Berlin: Deitrich Reimer Verlag.

Ouyang, Xiaoli. 2013. *Monetary role of silver and its administration in Mesopotamia during the Ur III period (c. 2112-2004 BCE): A case study of the Umma province*. Madrid: Consejo Superior de Investigaciones Cientificas.

Ouyang, Xiaoli, and Christine Proust. Forthcoming. Place value notations in the Ur III period: Marginal numbers in administrative texts. In *Cultures of computation and quantification*, eds. Karine Chemla, Agathe Keller, and Christine Proust. Dordrecht: Springer.

Owen, David I. 2013. Cuneiform texts primarily from Iri-Saĝrig/Āl-Šarrākī and the History of the Ur III period. In *Nisaba*, vol. 15. Bethesda, MD: CDL Press.

Parrot, André. 1933. Les fouilles de Tello et de Senkereh-Larsa, campagne 1932–1933. *Revue d'Assyriologie et d'Archéologie Orientale* 30: 169–182.

Parrot, André. 1934. *Villes enfouies: Trois campagnes de fouilles en Mésopotamie*. Paris: Éditions "Je sers".

Parrot, André. 1968. Les fouilles de Larsa. *Syria* 45: 205–239.

Paulette, Tate. 2016. Grain, storage, and state making in mesopotamia (3200-2000 BC). In *Storage in complex societies: Administration, organization, and control*, ed. Linda R. Manzanilla and Mitchell S. Rothman, 85–109. New York, London: Routledge.

Pemberton, W., J.N. Postgate, and R.F. Smyth. 1988. Canals and bunds, ancient and modern. *Bulletin of Sumerian Agriculture* 4: 207–221.

Peyronel, Luca. 2000. Some remarks on Mesopotamian metrology during the Old Babylonian period: The evidence from graves LG/23 and LG/45 at Ur. *Iraq* 62: 177–186.

Powell, Marvin A. 1971, 1973. *Sumerian numeration and metrology*. Ph.D. dissertation, University of Minnesota.

Powell, Marvin A. 1976. The antecedents of Old Babylonian place notation and the early history of Babylonian mathematics. *Historia Mathematica* 3: 417–439.

Powell, Marvin A. 1982. Metrological notes on the Esagila tablet and related matters. *Zeitschrift für Assyriologie und Vorderasiatische Archäologie* 72: 106–123.

Powell, Marvin A. 1984. Sumerian cereal crops. *Bulletin of Sumerian Agriculture* 1: 48–72.

Powell, Marvin A. 1987–1990. Maße und Gewichte. In *Reallexikon der Assyriologie und vorderasiatischen Archäologie* VII, eds. Dietz Otto Edzard, Erich Ebeling, and Bruno Meissner, 457–530. Berlin, New York: Walter de Gruyter.

Powell, Marvin A. 1988. Evidence for agriculture and waterworks in Babylonian mathematical texts. *Bulletin of Sumerian Agriculture* 4: 161–172.

Proust, Christine. 2000. La multiplication babylonienne: La part non écrite du calcul. *Revue d'Histoire des Mathématiques* 6: 293–303.

Proust, Christine. 2002. Numération centésimale de position à Mari. In *Florilegium Marianum 6: recueil d'études à la mémoire d'André Parrot*, ed. Dominique Charpin and Jean-Marie Durand, 513–516. Paris: Société pour l'Etude du Proche-Orient Ancien.

Proust, Christine. 2005. A propos d'un prisme du Louvre: Aspects de l'enseignement des mathématiques en Mésopotamie. *SCIAMVS—Sources and Commentaries in Exact Sciences* 6: 3–32.

Proust, Christine. 2007. *Tablettes mathématiques de Nippur*. Istanbul: IFEA, De Boccard.

Proust, Christine. 2008. *Tablettes mathématiques de la collection Hilprecht*. Leipzig: Harrassowitz.

Proust, Christine. 2009. Numerical and metrological graphemes: From cuneiform to transliteration. *Cuneiform Digital Library Journal* (001). https://cdli.ucla.edu/pubs/cdlj/2009/cdlj2009_001.html. Accessed 12 Dec 2012.

Proust, Christine. Forthcoming. Volume, brickage and capacity in Old Babylonian mathematical texts from southern Mesopotamia. In *Cultures of computation and quantification*, eds. Karine Chemla, Agathe Keller, and Christine Proust. Dordrecht: Springer.

Reade, Julian. 2001. Assyrian King-lists, the royal tombs of Ur, and Indus origins. *Journal of Near Eastern Studies* 60: 1–29.

Rede, Marcelo. 2005. Le 'Commerce sans marchéà l'époque de Hammu-Rabi'. Réévaluation d'une thèse polanyienne à partir d'une étude de cas. In *Autour de Polanyi. Vocabulaires, théories et modalités des échanges*, eds. Philippe Clancier, Francis Joannès, Pierre Rouillard, and Aline Tenu, 135–154. Paris: de Boccard.

Reiner, Erica. 1974. A Sumero-Akkadian hymn of Nanâ. *Journal of Near Eastern Studies* 33: 221–236.

Riftin, Aleksandre P. 1937. *Staro-vavilonskie iuridicheskie i administrativnye dokumenty v sobraniiakh SSSR*. Moscow: Izd-vo Akademii nauk SSSR.

Roaf, Michael. 1990. *Cultural atlas of Mesopotamia and the ancient near east*. Oxfordshire: Andromeda Oxford.

Robertson, John F. 1984. The internal political and economic structure of Old Babylonian Nippur: The Guennakkumand. His "house". *Journal of Cuneiform Studies* 36: 145–190.

Robertson, John F. 1992. The temple economy of Old Babylonian Nippur: The evidence for centralized management. In *Nippur at the centennial, papers read at the 35e Rencontre Assyriologique Internationale, Philadelphia, 1988*, ed. M. deJ. Ellis, 177–188. Philadelphia: S. N. Kramer Fund.

Robson, Eleanor. 1999. Mesopotamian mathematics 2100–1600 BC: Technical constants in bureaucracy and education. In *Oxford editions of Cuneiform texts*, vol. 14. Oxford: Clarendon Press.

Robson, Eleanor. 2000. Mathematical cuneiform tablets in Philadelphia. Part 1: Problems and calculations. *SCIAMVS—Sources and Commentaries in Exact Sciences* 1: 11–48.

Robson, Eleanor. 2001. Neither Sherlock Holmes nor Babylon: A reassessment of Plimpton 322. *Historia Mathematica* 28: 167–206.

Robson, Eleanor. 2001. The tablet house: A scribal school in Old Babylonian Nippur. *Revue d'Assyriologie et d'Archéologie Orientale* 95: 39–66.

Robson, Eleanor. 2002. Guaranteed genuine originals: The Plimpton collection and the early history of mathematical Assyriology. In *Mining the archives: Festschrift for C. B. F. Walker*, ed. C. Wunsch, 245–292. Dresden: ISLET.

Robson, Eleanor. 2004. Accounting for change: The development of tabular book-keeping in early Mesopotamia. In *Creating economic order: Record-keeping, standardization, and the development of accounting in the ancient near east*, ed. Michael Hudson and Cornelia Wunsch, 107–144. Bethesda, MD: CDL Press.

Robson, Eleanor. 2004b. Mathematical cuneiform tablets in the Ashmolean Museum, Oxford. *SCIAMVS—Sources and Commentaries in Exact Sciences* 5: 3–65.

Robson, Eleanor. 2014. *Old Babylonian tabular accounts*. http://oracc.museum.upenn.edu/obta/. Accessed 30 June 2018.

Sachs, Abraham J. 1947. Babylonian mathematical texts I. Reciprocals of regular sexagesimal numbers. *Journal of Cuneiform Studies* 1: 219–240.

Sachs, Abraham J. 1952. Babylonian mathematical texts II-III. *Journal of Cuneiform Studies* 6: 151–156.

Sallaberger, Walther. 1999. Tiel II: Ur III-Zeit. In *Mesopotamien: Akkad-Zeit und Ur III-Zeit*, eds. Walther Sallaberger, and Aage Westenholz, 119–390. Freiburg and Göttingen: Universitätsverlag, Vandenhoeck and Ruprecht.

Sallaberger, Walther. Forthcoming. Measuring grain in early bronze age Mesopotamia: Form, use and control of the bariga container in the 21st century BCE. In *Cultures of computation and quantification*, eds. Karine Chemla, Agathe Keller, and Christine Proust. Dordrecht: Springer.

Salonen, Armas. 1970. *Die Fischerei im alten Mesopotamien nach sumerich-akkadischen Quellen*. Helsinki: Suomalainen Tiedeakatemia.

Sasson, Jack. 2002. The Burden of Scribes. In *Riches hidden in secret places: Ancient near eastern studies in memory of Thorkild Jacobsen*, ed. T. Jacobsen and T.I. Abusch, 211–228. Winona Lakes, IN: Eisenbrauns.

Scheil, Vincent. 1918. Sur le marché aux poissons de Larsa. *Revue d'Assyriologie et d'Archéologie Orientale* 15: 183–194.

Sigrist, Marcel. 1990. Old Babylonian account texts in the Horn Museum. In *Andrews University cuneiform texts IV*. Berrien Springs, MI: Andrews University Press.

Simmons, Stephen D. 1978. Early Old Babylonian documents. In *Yale oriental series, Babylonian texts*, vol. 14. New Haven, London: Yale University Press.

Snell, Daniel C. 1982. Ledgers and prices: Early Mesopotamian merchant accounts. In *Near eastern researches*, vol. 8. New Haven, London: Yale University Press.

Sollberger, Edmond. 1966. The business and administrative correspondence under the kings of Ur. In *Texts from Cuneiform sources*, vol. 1. Locust Valley, NY: J.J. Augustin.

Spada, Gabriella. 2011. A handbook from the Eduba'a: An Old Babylonian collection of model contracts. *Zeitschrift für Assyriologie und Vorderasiatische Archäologie* 101: 204–245.

Steele, Francis. 1951. Writing and history: The new tablets from Nippur. *University Museum Bulletin* 16: 21–27.

Steinkeller, Piotr. 1995, 1996. Review of 'Die lexikalischen Listen der archaischen Texte aus Uruk (=Archaische Texte aus Uruk, Band 3; Ausgrabungen der Deutschen Forschungsgemeinschaft in Uruk-Warka, Band 13)' by Robert K. Englund, Hans J. Nissen, and Peter Damerow. *Archiv für Orientforschung* 42–43: 211–214.

Steinkeller, Piotr. 2001. New light on the hydrology and topography of southern Babylonia in the third millennium. *Zeitschrift für Assyriologie und Vorderasiatische Archäologie* 91: 22–84.

Steinkeller, Piotr. 2003. Archival practices at Babylonia in the third millennium. In *Ancient archives and archival traditions: Concepts of record-keeping in the ancient world*, ed. Maria Brosius, 37–58. Oxford: Oxford University Press.

Steinkeller, Piotr. 2004. The function of written documentation in the administrative praxis of early Babylonia. In *Creating economic order: Record-keeping, standardization, and the development of accounting in the ancient near east*, ed. Michael Hudson and Cornelia Wunsch, 65–88. Bethesda, MD: CDL Press.

Stol, Marten. 1976. Studies in Old Babylonian history. In *Uitgaven van het Nederlands historisch-archaeologisch instituut te Istanbul*, vol. 40. Leiden: Nederlands Historisch-Archaeologisch Instituut te Istanbul.

Stol, Marten. 1982. State and private business in the land of Larsa. *Journal of Cuneiform Studies* 34: 127–230.

Stol, Marten. 1984. Processing of cereals in the cuneiform record. *Bulletin of Sumerian Agriculture* 1: 103–113.

Stol, Marten. 1994. Constant factors in Old Babylonian texts on plowing with the *inītum*. In *Cinquante-deux réflexions sur le Proche-Orient ancien offertes en hommage à Léon de Meyer*, eds. H. Gasche, Michel Tanret, C. Janssen, and A. Degraeve, 229–235. Louvain, Paris: Peeters.

Stol, Marten. 2004. Wirtschaft und Gesellschaft in altbabylonischer Zeit. In *Mesopotamien: Die altbabylonische Zeit*, eds. Dietz Otto Edzard, Dominique Charpin, and Marten Stol, 643–975. Freiburg and Göttingen: Universitätsverlag, Vandenhoeck and Ruprecht.

Soubeyran, Denis. 1984. Chap. IV. In *Archives administratives de Mari* I, eds. Francis Joannès, Guillaume Bardet, Bertrand Lafont, Denis Soubeyran, and Pierre Villard, 327–452. Paris: Editions Recherche sur les Civilisations.

Thomsen, Marie-Louise. 1984. *The Sumerian language: An introduction to its history and grammatical structure*. Copenhagen: Akademisk Forlag.

Thureau-Dangin, François. 1900. GAN, SAR et TU mesures de volume. *Zeitschrift für Assyriologie und Vorderasiatische Archäologie* 15: 112–114.

Thureau-Dangin, François. 1922. Tablettes d'Uruk à l'usage des prêtres du Temple d'Anu au temps des Séleucides. In *Musée du Louvre, Département des Antiquités Orientales, Textes Cunéiformes*, vol. 6. Paris: Paul Geuthner.

Thureau-Dangin, François. 1924. La correspondence de Ḫammurapi avec Šamaš-ḫaṣir. *Revue d'Assyriologie et d'Archéologie Orientale* 21: 1–58.

Thureau-Dangin, François. 1930. La graphie du système sexagésimal. *Revue d'Assyriologie et d'Archéologie Orientale* 27: 73–78.

Thureau-Dangin, François. 1932. La mesure du "QA". *Revue d'Assyriologie et d'Archéologie Orientale* 29: 189–192.

Thureau-Dangin, François. 1938. *Textes mathématiques babyloniens*. Book series: *Ex Oriente Lux* 1. Leiden: E. J. Brill.

Tinney, Steve. 1999. On the curricular setting of Sumerian literature. *Iraq* 61: 159–172.

Tyborowski, Witold. 2003. Šēp-Sîn, a private businessman of the Old Babylonian Larsa. *Die Welt des Orients* 33: 68–88.

Van de Mieroop, Marc. 1987. *Crafts in the early Isin period: A study of the Isin craft archive from the reigns of Išbi-Erra and Šu-Ilišu*. Leuven: Departement Oriëntalistiek.

Van de Mieroop, Marc. 1992. *Society and enterprise in Old Babylonian Ur*. Berlin: Dietrich Reimer Verlag.

Van de Mieroop, Marc. 1993. The reign of Rīm-Sîn. *Revue d'Assyriologie et d'Archéologie Orientale* 87: 47–69.

Van de Mieroop, Marc. 1999. *Cuneiform texts and the writing of history*. London, New York: Routledge.

Van de Mieroop, Marc. 2002. A history of Near Eastern debt? In *Debt and economic renewal in the ancient near east*, eds. Michael Hudson, and Marc Van de Mieroop, 59–94. Bethesda, MD: CDL Press.

Van de Mieroop, Marc. 2004. Accounting in early Mesopotamia: Some remarks. In *Creating economic order: Record-keeping, standardization, and the development of accounting in the ancient near east*, eds. Michael Hudson, and Cornelia Wunsch, 47–64. Bethesda, MD: CDL Press.

Van de Mieroop, Marc. 2005. *King Hammurabi of Babylon: A biography*. Oxford: Blackwell Publishing.

Veenhof, Klaas R. 1985. SAG.ÍL.LA = saggilû, "difference assessed". On measuring and accounting in some Old Babylonian texts. In *Miscellanea babylonica: Mélanges offerts à Maurice Birot*, eds. Jean-Marie Durand, and Jean R. Kupper, 285–306. Paris: Recherche sur les civilisations.

Veldhuis, Niek. 1997. *Elementary education at Nippur. The lists of trees and wooden objects*. Ph. D. dissertation, University of Groningen.

Veldhuis, Niek. 2001. A multiple month account from the Gu'abba rest house. *Zeitschrift für Assyriologie und Vorderasiatische Archäologie* 91: 85–109.

Veldhuis, Niek. 2011. Levels of literacy. In *The Oxford handbook of cuneiform culture*, ed. Karen Radner and Eleanor Robson, 68–89. Oxford: Oxford University Press.

Von Soden, Wolfram. 1985. *Akkadisches Handwörterbuch*, 3 vols. Weisbaden: Harrassowitz Verlag.

Waetzoldt, Hartmut. 2010. The colours and variety of fabrics from Mesopotamia during the Ur III period (2050 BC). In *Textile terminologies in the ancient near east and Mediterranean from the third to the first millennia BC*, ed. Marie-Louise Nosch and Cécile Michel, 201–209. Oxford, Oakville, CA: Oxbow Books.

Walters, Stanley. 1970. Water for Larsa: An Old Babylonian archive dealing with irrigation. In *Yale near eastern researches*, vol. 4. New Haven: Yale University Press.

Wilcke, Claus. 2000. Wer las und schrieb in Babylonien und Assyrien. Überlegungen zur Literalität im Alten Zweistromland. In *Bayerischen Akademie der Wissenschaften Philosophisch-historische Klasse 2000/2006*. Munich: Verlag der Bayerischen Akademie der Wissenschaften.

Yoffee, Norman. 1977. *The economic role of the crown in the Old Babylonian period*. Malibu, CA: Undena Publications.

Indexes to the Text Editions

Part I Akkadian and Sumerian Word index
Part II Name index listing personal names, divine names and geographic names
Part III Economic texts cited or edited in this volume
Part IV Mathematical text index cited or edited in this volume

nb: metrological lists and tables as well as numerical tables are catalogued in Appendix 3, unless they are edited or translated in this volume.

R. Middeke-Conlin, *The Making of a Scribe*, Why the Sciences of the Ancient World Matter 4, https://doi.org/10.1007/978-3-030-35951-5

Part I Akkadian and Sumerian Word Index

Words populating this list are derived from both mathematical and economic texts edited in this volume.

Akkadian

.

A

abum 'father'
a-bi-ša: Ashm 1922-277: 28
abullum 'gate'
a-bu-ul-lam: AO 08493: 7
aḫītum 'additional payment'
a-ḫi-a-tim: Ashm 1922-277: 1, 21
akalum 'food'
a-ka-al: food, AO 07034: 16
akālum 'to eat'
i-ku-lu: LB 1097: 3, 5, 12, 14
alākum 'to go'
il-li-ku: AO 07034: 5; YBC 07473: 33
amārum 'to read (with ṭuppum)'
in-nam-ru: Ashm 1922-277: 36
ana 'to, for'
a-na: AO 06760: 12, 16, 20, 32, 34, 41, 55, 58; AO 07034: 5, 7, 12, 15, 16, 19, 23, 25, 26, 31, 34-36; AO 08461: 30', 40'; AO 08493: 4, 16, 19, 21, 22, 26, 30; Ashm 1922-277: 4; Ashm 1922-281: 35; Ashm 1923-311: 35'; Ashm 1923-315: 19; AUAM 73.2672: 10; LB 1072: 9; LB 1091: 1-3, 6-9; LB 1092: 7; LB 1097: 21; LB 3051: 17, 22; VAT 08521: 1, 5, 6, 8, 10, 11; YBC 04224: 21; YBC 04265: 5; YBC 04663: 4-6, 44-46, 50; YBC 04721: 1; YBC 05586: 34; YBC 04216: 1; YBC 07195: 12, 13, 38; YBC 07473: 31, 33, 48', 49', 57'; YBC 07787: 6, 12
awīlum 'citizen'
a-wi-lim: AO 07034: 16
a-wi-lum: YBC 07473: 32
ayyābum 'enemy
a-a-bi: Ashm 1923-340: 4

B

babbilūtum 'service as bearer'
ba-ab-bi-lu-ut: YBC 04265: 8
bītum 'household'
bi-it: AO 06760: 32
bi-tim: AO 06760: 56; YBC 06216: 1, 13
būrtum'a kind of vessel'
bu-ur-tim: LB 1091: 7

D

damāqum 'to become good; D put in order'
u_2*-dam-mi-qu*: LB 1074: 6

E

ebbūtum 'craft and labor comptroller'
e-bu-tum: LB 1074: 13
eb-bu-tum: LB 1078: 15
ēdiḫum 'basket mender'
lu$_2$ *e-di-ḫu*: LB 1078: 05
elûm, 'to go up'
il-li: AO 08461: 30'
epēšum 'to work; D to calculate'
e-pi-iš: AO 07034: 15
u_2*-pi-iš-šu-ma*: AO 08493: 3
ēpītum 'female baker'

R. Middeke-Conlin, *The Making of a Scribe*, Why the Sciences of the Ancient World Matter 4, https://doi.org/10.1007/978-3-030-35951-5

e-pi-tum: LB 1091: 8
epûm ‘to bake’
e-pe-e-em: LB 1091: 1-3
erēšum ‘to cultivate, plow’
i-ri-ša-ma: LB 1097: 5
i-ri-šu-u$_2$*-ma*: Ashm 1923-311: 34’

G
gugutum ‘a kind of fodder’
gu-gu-«ra»-tum: Ashm 1923-315: 14

H
ḫāpirum ‘migrant’
ḫa-pi$_2$*-ru*: Ashm 1922-281: 14
ḫarāṣum ‘to break off; D to subtract; Št calculate, deduct’
ḫu-ru-uṣ$_4$: subtract, YBC 04663: 51
šu-taḫ-ru-uṣ: YBC 05586: 26, 37, 46
ḫepûm ‘to break’
ḫe$_2$*-pe*: YBC 04663: 47
ḫerrum ‘a kind of furrow’
ḫe-er-ru: Ashm 1923-311: 6, 13, 16, 25’
ḫerûm ‘to dig, excavate’
ih-re: YBC 07164: 16-18
u$_2$*-še-eḫ-ru*: YBC 12273: 11

I
idum ‘fee, wage’
i-di: AO 08493: 7
i-de-e: Ashm 1923-315: 15
i$_3$-di: Ashm 1922-277: 15; YBC 04663: 6
ina ‘in, by means of, from’
i-na: A.26371: 3; AO 06760: 34; AO 08493: 3, 6, 9, 17, 24; AO 08524: 9, 13, 16; ; Ashm 1922-281: 25, 26; Ashm 1923-311: 34’; LB 1075: 3; LB 3051: 28; NBC 06763: 8, 11; YBC 04265: 6; YBC 04663: 48; YBC 07195: 21
inītum ‘cattle’
i-ni-a-tum: LB 2053: 13
inūma ‘when’
i-nu-ma: LB 1097: 21; LB 1092: 7
īrḫum ‘quick’
ir-ḫu-um: AO 08461: 36’

K
kamkammatum ‘ring’
kam-kam-ma-tum: AO 07034: 34
kanākum ‘to seal’
ak-nu-ku-ma: AO 08524: 14
kaprum ‘village’
ka-ap-ri-im: YBC 07195: 35
kasāmum ‘to cut’
ka-sa$_3$*-mi-im*: YBC 07195: 14, 29
kasû ‘mustard’
ka-su$_2$-*u*$_2$: LB 1072: 10
kaṣārum ‘to consolidate’
ka-ṣa-ri-[im]: NBC 11509: 8
kāṣibum ‘reduced’
ka-aṣ-ba-tum: Ashm 1923-315: 3
kašādum ‘to finish (fieldwork), sow’
ik-šu-dam: LB 1097: 7
kidinnum ‘protection, protected one’
ki-di-num: Ashm 1923-315: 6
kima ‘like, instead of’
ki-ma: Ashm 1922-277: 6, 28, 29
kinkum ‘tag, sealing’
ki-in-ku-um: Ashm 1923-315: 11
kirbānum ‘lump (of earth)’
ki-ir-ba-ni-im: LB 1097: 23
kurummatum ‘allocation’
ku-ru-ma-at: AO 08493: 15
kuššatum ‘a kind of garment’
^{tug2}*ku-uš-ša-tum*: YBC 07473: 45’

L
l*aqātum* ‘to gather’
la-[*qa*$_2$*-at*] : LB 1097: 23
leqûm ‘to take’
le-qe$_2$: YBC 04663: 50
le-qu: YBC 07787: 9
le’ûm ‘to be able’
i-li-a-am: Ashm 1922-277: 37; Ashm 1923-311: 10; Ashm 1923-340: 7
libbum ‘heart, middle, center’
li-ib-ba-ku: YBC 07787: 10
li-ib-bi$_3$: Ashm 1922-281: 28
i-na li-bi: YBC 04663: 49
li-ib-bi... an-ni: AO 08524: 11
ša i-na li-ib-bi: NBC 06763: 8

M
magārum ‘to be compliant’
ma-ga-ru-um: AO 08461: 31’
maḫārum ‘to accept’
am-ḫu-ru: AO 08493: 6
im-maḫ-ru: AO 08524: 10
makkû ‘a kind of fee’
ma-ak-ku-u$_2$: YBC 06231: 10
mansûm ‘carrying basket/board’
^{gi}*ma-an-sim*:, LB 1072: 13
marāṣum ‘to become ill’

im-ra-ṣu: AO 08493: 33
maškanum ‘threshing floor’
ma-aš-ka-na-tim: LB 1074: 6
maššartum ‘withdrawal’
ma-aš-šar-tum: YBC 06216: 1
maštītum ‘drink (allowance)’
ma-aš-ti-tum: LB 1069: 9; LB 1078: 21; YBC 05494: 8; YBC 05586: 19, 21, 32; YBC 06231: 9; YBC 07194: 11
mâtum ‘to die’
i-mu-tu: AO 08493: 20
maṭûm‘to lower, become low’
im-ṭu$_2$*-u*: YBC 04224: 22
mayyārum ‘deep plowed’
ma-a-a-ru: LB 1097: 13
mû ‘water’
me-e: LB 3051: 17, 22
mūšum ‘night’
mu-ši-im: AO 08493: 17; AO 08524: 16
muzzaz bītim ‘house servant’
mu-uz$_x$-za-az e$_2$: LB 1078: 17
mu-za-az e$_2$: LB 1074: 14

N

nadānum ‘to give’
ad-di-nam: AO 08493: 24
ad-di-nu: AO 08493: 27
id-di-nu: AO 08493: 4
id-di-nu-šum-ma: Ashm 1923-311: 33’
i-di-in-ma: one gives, VAT 08521: 1
i-na-ad-di-ik-ku: YBC 04663: 3, 50
i-na-ad-di-ku: YBC 04663: 4, 5
i-na-di-ik-ku: YBC 04663: 45
i-na-di-ku: YBC 04663: 5, 6, 46-48, 51, 52
i-na-di-ku-um: YBC 04663: 44
i-na-di-nu-kum: VAT 08521: 4
in-na-ad-nu: AO 06760: 34, 56; LB 3051: 28; YBC 07473: 33, 48’
li-id-di-kum: VAT 08521: 2
li-id-di-nam: VAT 08521: 9
lu-ud-di-im-ma: VAT 08521: 8
u$_2$*-la id-di-in*: YBC 05586: 16
namḫartum ‘revenue’
na-am-ḫa-ar-ti: AO 08493: 2; AO 08524: 7; Ashm 1923-298: 5; AUAM 73.2672: 4
nappilum ‘accountant’
na-ap-pi$_2$*-lum*: Ashm 1923-340: 11
naptanum ‘(cultic) meal’
na-ap-ta-nu-um: Ashm 1924-453: 7, 19
nasāḫum ‘to take away, remove, excavate D tear out’
in-na-as-ḫu: NBC 06763: 9
is-su$_2$*-ḫu-ni-im*: LB 1097: 22
is-su$_2$*-uh*: YBC 07164: 19
na-as-ḫa: LB 1097: 11
u$_2$*-su*$_2$*-uh*: YBC 04663: 49
nāsikum ‘grain piler’
lu$_2$ *na-si*$_2$*-(i-)ku*: LB 1074: 9; LB 1078: 12
našûm ‘to lift, raise, carry’
i-ši: YBC 04663: 4-6, 44-46
iš-ši-a-[*nim*]: YBC 07195: 24
iš-šu-nim: LB 1074: 11
nēpešum ‘procedure’
ne$_2$*-pe-šu*: YBC 04663: 6
nadītum, ‘unimproved land’
ni-di-it: Ashm 1922-277: 22, 41

P

puqqum ‘to be attentive’
pu-qi$_2$*-im*: Ashm 1923-315: 10
paṭārum ‘to loosen; D to release, detach’
pu-ṭur-ma: VAT 08521: 6
pu-ṭu-ur: YBC 04663: 43

R

rakābum ‘to ride; Š to load’
u$_2$*-ša-ar-ki-bu*: YBC 07195: 22
rāpisum ‘thresher’
lu$_2$ *ra-pi-su*$_2$: LB 1074: 5
redûm ‘to accompany’
ir-de-a-am: AO 07034: 18, 21
rubbû ‘increase’
ru-ub-bu-u$_2$: YBC 07194: 8

S

sabsû ‘sac maker’
sa$_3$*-ab-su*$_2$*-um*: Ashm 1923-315: 8
sāmidum ‘miller’
sa$_3$*-mi-du-um*: LB 1072: 12
sāmum ‘reddish (grain)’
sa$_3$*-mu-um*: Ashm 1923-315: 4
sanāqum ‘to check (weight)’
is-sa-ni-qu: Ashm 1922-336: 4
sittum ‘remainder, deficit’
si-i$_3$*-tum*: AO 06760: 2; AO 08493: 36; LB 1072: 21; LB 1075: 13; M 10: 1, 3-6; YBC 04224: 35; YBC 07195: 34; YBC 07473: 60’; YBC 07787: 11
sihirtum ‘all, entirety’
si$_2$*-ḫi-ir-ti*: Riftin 1937: no. 116: 6
sūtum ‘concession’
su$_2$*-ti*(*m*): AUAM 73.2672: 10; YBC 07787: 12

Ṣ

ṣibtum ‘interest’
ṣi-ib-tim: YBC 07194: 7

ṣitum 'exit'
ṣi-ta-am: AO 08493: 8
ṣuḫartum 'girl'
ṣu-ḫa-ar-tum: AO 06760: 56

Š

ša 'of, which, who'
ša: AO 06760: 32; AO 07034: 11, 17, 21, 26, 29; AO 08461: 23', 24', 27', 31'-34', 39'; AO 08493: 3, 4, 6, 8, 16, 23, 26, 30; AO 08524: 3, 5, 9, 13; Ashm 1922-277: 4, 6, 8, 15, 21, 29, 35; Ashm 1923-311: 10, 29', 30'; Ashm 1923-315: 1, 5, 9, 17; Ashm 1923-336: 3, 4; Ashm 1923-340: 2, 20; LB 1074: 1-3, 11; LB 1075: 3; LB 1078: 1, 2, 6, 9, 10; LB 1097: 3, 5, 7-9, 11, 13, 14, 19; LB 2053: 2-9, 11, 12; LB 3051: 28; NBC 06763: 8, 11; Riftin 1937: no. 116: 2, 4; VAT 08521: 4, 6; YBC 04224: 21; YBC 04265: 4; YBC 04663: 46; YBC 05586: 22, 33, 34; YBC 07194: 7, 8, 21; YBC 07195: 5, 7, 15, 18, 23, 30, 35; YBC 07473: 33, 48', 57'; YBC 07744: 1, 4
šadādum 'to survey'
iš-ta-ad-du: Ashm 1923-340: 2
šaḫarrum 'a kind of net, binder'
lu$_2$ *ša-ḫa-ar-rum*: LB 1074: 2
šakākum 'to harrow'
iš-ku-ku(*-ma*): LB 1097: 3, 12
ša-ka-ki-im: LB 2053: 11
ša-ka-ku: LB 1097: 1
šakkum 'harrowed'
ša-ak-ki: LB 1097: 8
šakānum 'to set, place, impose'
i-ša-ka-nu: Riftin 1937: no. 116: 4
ša-ak-nu: Ashm 1923-311: 10; Ashm 1923-340: 7; VAT 08521: 6
šalāmum 'to become healthy, recover'
iš-li-mu: AO 06760: 17
šamāṭum 'to tear away; D to shave off'
u$_3$*-ša-mi-iṭ*: YBC 07164: 20
šammum 'grass'
ša-am-mi: LB 1097: 10
šâmum 'to buy'
i-ša-am: YBC 07787: 7
šanûm 'to do twice; D to remeasure'
u$_2$*-ša-an-nu*: AO 08493: 9
šapākum 'to heap up'
ša-pa-ki-im: YBC 07195: 12
šaqûm 'to irrigate'
ša-qi$_2$*-im*: LB 3051: 17, 22
šarrum 'king'
šar-rum: AO 08493: 3
šar-ru-um: Riftin 1937: no. 116: 4
šeberum 'to break'
še$_{20}$*-be*$_2$*-ri-im*: LB 2053:11
še$_{20}$*-be*$_2$*-rum*: LB 1097: 2
šebrum 'broken'
še$_{20}$*-eb-ri*: LB 1097: 8
še$_{20}$*-eb-ri-ti*: LB 1097: 9
šikkatum I flask
ši-ka-tim: LB 1091: 6
šikkatum II 'harrowed'
ši-ik-ka-at: LB 1097: 10
ši-ik-ka-tim: LB 1097: 9
šilūtum 'throw out work'
ši-lu-ta-am: YBC 07164: 16
ši-lu-tum: YBC 07164: 15
šimtum 'fate, death'
ši-im-tim: AO 07034: 35
šiprum 'work'
ši-ip-ri-im: AO 07034: 15
šukunnum 'estimated yield'
šu-ku-un-na: Ashm 1922-277: 1; Ashm 1923-340: 1
šumma 'if'
šum-ma: VAT 08521: 8
šuplum 'depth'
šu-<up-lum>: YBC 07164: 15, 16
šūrum 'reeds'
šu-ur: YBC 07195: 13

T

tablittum 'sustenance'
ta-ab-li-tum: LB 1097: 19
tadnintum 'additional'
ta-ad-ni-in-tim: YBC 07195: 5, 7, 30
ta-ad-ni-in-tum: YBC 07195: 4
tākultum '(cultic) meal'
ta-ku-ul-tim: AO 08493: 19
tamlīum 'filling'
ta-am-lu-u$_2$: YBC 07195: 15
taraḫḫu 'lining'
ta-ra-hi-ša: YBC 07164: 20
tebûm: 'to stand (in for)'
it-bu-u$_2$: Ashm 1922-277: 4, 28, 29
tēbibtum 'census'
te-bi-ib-tum: YBC 04224: 20
terdītum 'expanded (volume)'
te-er-di-is-sa$_3$: YBC 07164: 20
târum 'to turn; D bring back, pay back, return'
tu-ur-ma: YBC 04265: 6
u$_2$*-te-er-ru*: Ashm 1923-311: 36'
u$_2$*-te-er-ru-nim*: AO 07034: 14

Ṭ

ṭâbum 'to become satisfied'
li-ib-ba-ku ta-a-ab: YBC 07787: 10
ṭuppum 'tablet'
tup-pi: Ashm 1922-277: 36

U

ušallum 'meadow (along river flat/valley bottom)'
u$_2$-ša-la-tim: NBC 06763: 11

W

wabālum 'to bring, carry'
ub-lam: AO 07034: 29
ub-lu-u$_2$-nim: AO 06760: 32
u$_2$-ša-bi-lam: YBC 07195: 36
u$_2$-ša-bi-la-ak-ki-im, AO 08524: 18
waṣabum 'to add'
i-wa-ṣa-bu: LB 1075: 4
ṣi$_2$-ib: YBC 04663: 51

Z

zabālum 'to carry, deliver'
iz-bi-lu-nim: YBC 05586: 35

Sumerian

.

Number

^{gis}3(ban$_2$) '3 *ban*-standard vessel'
A.26371: 3

A

a-ab-ba 'sea'
Ashm 1922-281: 10; YBC 07787: 2
a-ba 'wages'
LB 1072: 9, 15
a-kar$_2$-kar$_2$^{ku6} 'a kind of fish'
YBC 07744: 4
a-na 'as, as much as'
YBC 04698: 1, 3, 17
a-ra$_2$ 'multiplication'
VAT 08521: 4, 6
a-ša$_3$ 'field, area'
AO 08461: 27', 39'; Ashm 1922-277: 1, 3, 18; Ashm 1923-311: 1, 4, 7, 11, 14, 17, 21; Ashm 1923-340: 2; LB 1097: 1, 2, 4, 5, 7, 9, 12, 13, 17; YBC 07195: 28; a-ša$_3$-bi: IM 57828: 5, 6; Ni 18: 5, 6
a-ša$_3$ gid$_2$: Ashm 1923-311: 1, 4, 7, 11, 14, 17, 21, 26'
^{munus}a-zu '(female) doctor'
AO 08493: 27
a$_2$ 'wage, fee, edge'
YBC 05586: 18, 21, 32, 34; YBC 05494: 7, 9; YBC 05586: 16; YBC 07194: 10, 12; YBC 07195: 15, 23
a$_2$-bi: LB 1074: 10; LB 3051: 2, 24; YBC 04663: 1, 42, 43; YBC 04666: 2
ab-sin$_2$ 'furrow'
Ashm 1922-277: 3; Ashm 1923-311: 2, 5, 8, 12, 15, 18, 22, 24'; Ashm 1923-340: 2, 5; LB 1097: 4
ada 'father'
ad-da-ni: Ashm 1922-277: 4
aga-uš '*rēdûm*'
Ashm 1922-277: 11, 19', 33; LB 1074: 12; LB 1078: 16
aga-uš^{meš}: Ashm 1922-277: 1, 4, 6, 42, 44; Ashm 1923-340: 2
aga$_2$ 'to measure out'
i$_3$-ag$_2$-e: A.26371: 9
an-na 'tin'
AO 06760: 58; YBC 07473: 42'
anše 'donkey'
anše-ḫi-a: AO 08493: 7

B

^{giš}ba-an '*ban*-standard vessel'
YBC 04224: 43
^{giš}ba-an 1(ban$_2$) '1 *ban*-standard vessel'
YBC 04265: 5
^{giš}ba-ri$_2$-ga '*bariga*-standard vessel'
YBC 04265: 2; YBC 07194: 8
ba-zi: 'disbursed'
AO 06760: 60; AO 08461: 42', 48'; LB 1072: 19; LB 1074: 16; LB 3051: 6; YBC 05494: 11; YBC 05586: 25, 36, 45; YBC 06216: 14; YBC 06231: 13; YBC 07194: 14; YBC 07473: 59'
bad$_3$ 'wall'
NBC 05474: 9
bala-re 'other side'
Ashm 1923-311: 38'; Ashm 1923-340: 4
bappir 'a beer production ingredient'
LB 1075: 1
^{tug2}bar-dul$_8$ 'robe'
AO 06760: 16; YBC 07473: 41'
^{tug2}bar-sig$_9$: 'a sash or headdress'
AO 06760: 28, 29
bulug: 'to sew'
AO 08461: 40'

bur$_3$ ‘depth’
bur$_3$-bi YBC 04663: 1, 4, 41, 46; YBC 04666: 1; YBC 07164: 15, 19; bur$_3$-u: NBC 06763: 1; YBC 12273: 1

D

^{na4}da-gaz-babbar-dili: ‘agate? block’
YBC 07473: 29
dagal I ‘width
NBC 06763: 1; NBC 11509: 1; YBC 04666: 1; YBC 07164: 15, 19; YBC 12273: 1, 8
dagal II ‘broad’
YBC 05494: 6; YBC 07194: 6
daḫ ‘to add’
daḫ-ḫe-dam: A.26371: 2
dal: ‘transversal’
YBC 04669: 10
dalla ‘crown’
AO 07034: 34
dam-gar$_3$ ‘merchant ‘
dam-gar$_3$^{meš}: Ashm 1922-336: 7
didli: individual
Ashm 1922-277: 41; Ashm 1923-340: 21
dig-ku$_6$ ‘softened fish’
YBC 07744: 1
dilib ‘hairy’
AO 06760: 29
diri ‘excess’
AO 06760: 61; M 10: 2
du$_3$-an ‘sun drying’
NBC 09050: 12, 14
du$_8$ ‘detach’
YBC 04663: 5, 46
dub-šar ‘scribe’
Ashm 1922-277: 10
duḫ ‘bran’
AO 08461: 24’; LB 2053: 2, 4, 6, 8, 10
duḫ-bi: LB 1078: 13
dumu ‘son, citizen’
A.26371: 18; AO 06760: 10; AO 07034: 10; YBC 04265: sealing 2
dumu^{meš}: AO 07034: 9, 17
dumu-munus ‘daughter’
YBC 07473: 31, 48’; AO 06760: 17, 20
dumu-munus lugal ‘princess’
YBC 07473: 32
dušu “basket’ work’
YBC 07164: 16-18

E

e$_2$ ‘house, household, temple’
AO 08493: 16; Ashm 1922-277: 15; Ashm 1932-378: 4; Ashm 1924-453: 9, 10, 20, 21; LB 1072: 3, 7; LB 3051: 24; YBC 05494: 6; YBC 05586: 5, 30, 35, 43; YBC 06231: 7; YBC 07194: 6; YBC 07473: 48’
e$_2$-gal ‘palace’
Ashm 1922-277: 22, 39; Ashm 1923-311: 33’; Ashm 1923-340: 6; Riftin 1937: no. 116: 6
YBC 04224: 14, 30; YBC 07787: 3
e$_2$ kišib-ba ‘sealed storeroom’
LB 1072: 1; YBC 05494: 6; YBC 06216: 13; YBC 06231: 7; YBC 07194: 6
e$_3$ ‘to go out, rise’
he$_2$-e$_3$: YBC 04698: 19
ed$_3$ ‘to exit, fall’
he$_2$-e$_{11}$: YBC 04698: 20
eden ‘plain’
Ashm 1923-315: 23
eg$_2$ ‘levee’
YBC 07195: 12
^{na4}ellag$_2$-babbar-dili ‘agate bead’
YBC 07473: 28
en-nam ‘what’
IM 57828: 5; Ni 18: 5; VAT 08521: 12; YBC 04607: 3, 8, 12, 18, 22; YBC 04663: 2, 42; YBC 04666: 3; YBC 04669: 11; ; YBC 04698: 3, 6; YBC 07164: 17, 20
ensi$_2$ ‘farmer’
Ashm 1922-277: 5, 7, 9, 13, 15, 20, 24, 27, 34, 37, 40
ensi$_2$^{meš}: YBC 04224: 15
^{giš}eren ‘cedar’
AO 08464: 11
erin$_2$ ‘men, troops’
AO 08461: 36’; Ashm 1922-277: 6, 8, 14, 15, 29, 30; Ashm 1922-281: 1, 10, 14, 16, 18, 27-30; Ashm 1924-453: 5, 6, 17, 18; LB 1069: 1, 3, 5, 7; LB 1074: 10, 13-15; LB 1078: 1-3, 6, 7, 9, 10, 19; Riftin 1937: no. 116: 6; NBC 06339: 1, 2, 4, 6, 8-3, 15, 16; YBC 04224: 16, 18
erin$_2$-bi: YBC 04721: 14; YBC 12273: 1
erin$_2$-ḫi-a: NBC 06339: 18; Riftin 1937: no. 116: 1; YBC 04663: 2
YBC 04666: 3, 4
eš-ma-ad-ga$_2$ ‘a kind of flour’
LB 1072: 14
eš$_2$ ‘flour’
AO 08461: 31’; Ashm 1923-315: 5
eš$_2$-gar$_3$ ‘work assignment’
Ashm 1923-340: 7, 20; YBC 04224: 20; YBC 04663: 1, 5, 42, 45; YBC 04666: 2; YBC 12273: 1

ezem ‘festival’
Riftin 1937: no. 116: 7

G

ga-ar$_3$ ‘cheese’
YBC 04224: 2, 5
gada ‘linen’
AO 07034: 30
gagar ‘base’
YBC 04607: 3, 8, 9, 12, 18, 19, 22, 23YBC 04663: 2; YBC 04666: 3
gagar-bi: YBC 04607: 4
gam ‘depth’
NBC 06763: 1; NBC 11509: 1
ganam$_4$ ‘ewe’
AO 08464: 24, 26
ganba ‘going rate’
NBC 08014: 3; YBC 04698: 17, 18, 21; YBC 07744: 2, 5, 7, 9, 11
gar-gar I ‘addition’
YBC 04224: 21
gar-gar II ‘to heap up, add’
YBC 04663: 41
gar-gar-*ru*: YBC 04663: 47
gar-ra ‘set’
VAT 08521: 3, 4
geme$_2$ ‘(female) slave’
AO 07034: 21; AO 08461: 31’; LB 1082: 4; YBC 07195: 25; YBC 08758: 2, 9
gi ‘reeds’
Ashm 1923-315: 7
gi-na ‘established’
A.26371: 3
gibil ‘new’
YBC 05494: 6; YBC 06231: 7; YBC 07194: 6
gid$_2$ I ‘breadth’
NBC 11509: 1
gid$_2$ II ‘broad, long’
Ashm 1923-311: 1, 4, 7, 11, 14, 17, 21, 26’
gid$_2$-da: YBC 06231: 7
gin ‘average’
AO 06760: 6; YBC 07473: 4
giri$_3$‘transport’
AO 06760: 48, 52; AO 07034: 4, 8, 37; AO 08493: 17, 21, 22, 28, 31; Ashm 1922-281: 32, 36; Ashm 1923-340: 27; Ashm 1923-340: 27; NBC 08014: 5; ; YBC 04224: 23, 40; YBC 05586: 8, 9, 12, 16, 27, 38; YBC 06231: 15; YBC 07194: 16; YBC 07195: 20
giš-tag-ga ‘sacrifice
AO 08464: 34
gu$_2$ ‘bank (of a canal)’
Ashm 1923-311: 38’; YBC 05586: 34
gu$_2$-un ‘rent’
Ashm 1922-277: 46; YBC 04721: 13
gu$_4$ ‘ox’
LB 1072: 5; YBC 07195: 4, 30
gu$_4$-ḫi-a: AO 08461: 22’; Ashm 1923-311: 29’, 30’, 31’, 36’; LB 1078: 13, 21; LB 1097: 19, 21; YBC 07195: 7
gu$_4$-niga: YBC 07195: 18
gu$_7$-gu$_7$-ta ‘make encounter’
YBC 04663: 3, 48
guru$_7$ ‘granary’
YBC 05586: 5, 30, 35, 43; YBC 07194: 9

H

ḫar-šu ‘ring’
AO 06760: 15; YBC 07473: 30, 47’

I

i$_3$-dab$_5$ ‘charge (of)’
NBC 06763: 16; NBC 11509: 9; YBC 12273: 4, 11
i$_3$-geš ‘common oil’
AO 08464: 6; YBC 04698: 8, 10
i$_3$-nun ‘butter’
AO 06760: 21, 42, 55; YBC 04224: 2, 5
i$_3$-sag ‘premium oil’
AO 08464: 8, 10
i$_3$-šam$_2$ ‘equivalent capacity’
YBC 04607: 3, 5, 8, 8, 12, 18, 22
i$_7$ ‘canal’
NBC 05474: 10
i$_7$-da: NBC 06763: 8; YBC 05586: 34
ib$_2$-si$_8$ ‘equal sides, square root’
IM 57828: 4; Ni 18: 4; VAT 08521: 2, 4, 13; YBC 04663: 50
igi I ‘reciprocal’
M 10: 1-6; VAT 08521: 6; YBC 04663: 5, 43, 46
igi II ‘before’
A.26371: 10, 11, 13, 15, 17; YBC 04265: 10-14
igi-du-a ‘controller’
Ashm 1922-277: 1
igi-du$_8$-bi: Ashm 1922-277: 15
igi-te-en ‘fraction’
YBC 07164: 16, 17
il$_2$ ‘raise’
VAT 08521: 5, 7, 10, 11
im-ba ‘deficit’
LB 3051: 28
im-du$_3$-a ‘built wall’
YBC 07195: 15
in-nu-da ‘straw’

YBC 05768: 3; YBC 07195: 23
ir$_3$ ‘(male) servant’
Ashm 1924-453: 9, 20; YBC 07787: sealing 3
ir$_3$-ḫi-a: AO 07034: 21; YBC 07195:25
iti ‘month’
A.26371: 19; AO 06760: 34; AO 07034: 39; AO 08461: 45’; AO 08464: 35, 38; AO 08493: 18, 21, 23, 24, 29, 31, 35; AO 08524: 8, 20; Ashm 1922-277: 50; Ashm 1922-281: 37; Ashm 1923-311: 32’, 34’, 40’; Ashm 1922-336: 8; Ashm 1923-315: 5; Ashm 1923: 340: 28; AUAM 73.2672: 11; LB 1069: 12; LB 1072: 8, 22; LB 1074: 21; LB 1075: 15; LB 1078: 24; LB 1091: 36; LB 2053: 1, 12; LB 3051: 19, 29; NBC 05474: 11; NBC 06339: 20; NBC 06763: 18; NBC 08014: 12; NBC 11509: 11; Riftin 1937: no. 116: 2, 7; YBC 04265: 16; YBC 04721: 15; YBC 05494: 19; YBC 05586: 48; YBC 06216: 15; YBC 06231: 22; YBC 07194: 20; YBC 07195: 5, 7, 30, 37; YBC 07473: 18, 62’; YBC 07744: 19; YBC 07787: 18; YBC 12273: 12

K
ka ‘mouth’
Ashm 1923-315: 2, 19’; NBC 05474: 10
kar ‘fixed rate’
AO 08464: 2, 4, 6, 10, 15, 16, 18, 20, 22, 24, 26, 28, 29
kar-bi: AO 06760: 4, 7, 13, 18, 21, 24, 26, 30, 36, 39, 42, 46, 50; AUAM 73.2672: 2; YBC 04224: 27; YBC 07473: 2, 4, 10, 13, 23, 25, 42’, 52’, 55’
kaskal ‘road’
Ashm 1922-277: 44
kaš ‘beer’
AO 07034: 15, 22, 26; LB 1072: 16
ki ‘place’
Ashm 1923-311: 39’; Ashm 1923-315: 11-13; Ashm 1923-340: 8, 9; LB 1074: 20; LB 1092: 1-3; NBC 06763: 3-7, 10; NBC 11509: 2-7; YBC 12273: 2, 3
ki II ‘after, from’
A.26371: 4; AO 06760: 60, 62; AO 08493: 14, 18, 22, 25, 29, 34, 35; AO 08524: 8, 21; AUAM 73.2672: 6; LB 1072: 22, 23; LB 1074: 22; LB 1075: 16; LB 1078: 22; LB 3051: 30; NBC 06763: 19; Riftin 1937: no. 116: 8; YBC 04224: 38, 50; YBC 04265: 9; YBC 07473: 61’; YBC 07744: 17; YBC 07787: 4
ki-gal$_2$ ‘threshing floor’
YBC 07194: 6
ki-la$_2$ ‘trench, weight’
YBC 04663: 1, 40, 41
ki-la$_2$-bi: AO 06760: 15; YBC 07473: 30, 47’
^{giš}kiri$_6$ ‘garden’
YBC 07195: 13, 16, 17
kišib ‘seal’
A.26371: LoE, LeE
kišib ib$_2$-ra ‘sealing’
kišib ib$_2$-ra-ḫi-a: YBC 04224: 30
kišib… ra ‘to impress a seal’
kišib-a-ni ib$_2$-ra: Ashm 1923-311: 39’; YBC 04265: 15; YBC 07787: 17
ku$_3$ ‘silver’
YBC 04663: 44
ku$_3$-babbar ‘silver’
AO 06760: 1, 9, 15, 35, 58, 61; AO 07034: 1, 34, 35; Ashm 1922-336: 2; Ashm 1923-315: 2; LB 3051: 11, 26; MS 2830: 1, 6; NBC 08014: 1; VAT 08521: 1, 7, 8, 12; YBC 04224: 1, 13; YBC 04663: 2, 41, 44; YBC 04698: 9; YBC 07473: 20, 28, 30, 49’, 58’; YBC 07787: 1, 6, 11
ku$_3$-bi ‘its silver’
AO 06760: 5, 8, 14, 16, 19, 22, 25, 27, 31, 33, 37, 40, 43, 47, 51, 53-55; AO 08464: 3, 5, 7, 9, 10, 15, 17, 19, 21, 23, 25, 27, 28, 30; AUAM 73.2672: 3; YBC 04224: 27, 41; YBC 07473: 3, 5, 8, 11, 14, 24, 26, 27, 34, 35’, 37’-41’, 43’, 46’, 53’, 56’; YBC 07744: 3, 6, 8, 10, 13
ku$_3$-gi ‘gold’
AO 06760: 18, 39, 45; AO 08464: 2, 4; NBC 08014: 2; YBC 07473: 52’
ku$_6$ ‘fish’
AO 07034: 29; YBC 07787: 2
kun-zi ‘weir’
NBC 05474: 9; NBC 06339: 19
kun-zi-da: Ashm 1923-315: 16
kurum$_6$ ‘allocation’
YBC 07473: 54’
kurun$_2$ ‘brewers’
Ashm 1924-453: 15
kurun$_2^{meš}$: Ashm 1924-453: 3

L
^{kuš}la ‘leather sack’
AO 08524: 13

lal ‘to weigh out’
i_3-la_2-e: YBC 07787: 12
la’u_4 ‘arrears’
YBC 05494: 12; YBC 05586: 26, 38, 47; YBC 06231: 14; YBC 07194: 15
^{giš}li-wi-ir ‘white cedar’
AO 08464: 14
libir ‘old’
AO 06760: 2; YBC 07164: 19
lu_2 ‘man/men, persons’
Ashm 1922-277: 41; Ashm 1923-340: 21; LB 1074: 6; YBC 04721: 13; YBC 07164: 16
lu_2 al-tar ‘workers’
AO 08461: 27’, 39’
lu_2 azlag ‘textile cleaner’
lu_2 $azlag^{meš}$ AO 07034: 23
lu_2 gub-ba ‘(male) ecstatic’
AO 07034: 11
lu_2 ḫun-ga_2 ‘hired hand’
LB 1074: 7, 10; LB 1078: 19; YBC 04666: 2; YBC 05586: 21, 32
$lu_2^{giš}ma_2$ ‘boatmen’
AO 08461: 29’, 32’-34’
lu_2 še-il_2 ‘grain porters’
LB 3051: 5; YBC 05494: 9; YBC 05586: 18, 23, 34; YBC 06231: 11; YBC 07194: 12
lu_2 še-kin-ku_5 ‘harvester’
LB 1069: 1, 7
lu_2 še-ur_4-ur_4 ‘gatherers’
LB 1069: 5; LB 1074: 4
lu_2 tu-tab-ba ‘binders’
LB 1069: 3
lu_2 tug_2 ‘weaver’
LB 1072: 17
lu-ku-ur: ‘a celibate priestess, *nadītum*’
AO 07034: 31
lugal ‘king’
YBC 04224: 28
lugal II ‘royal’
AO 08464: 34

M

^{giš}ma_2 ‘ship
LB 3051: 2; YBC 05586: 16
ma_2-ḫi-a: YBC 07194: 10; YBC 07195: 23
^{giš}ma_2-ḫi-a: YBC 05494: 7; YBC 05586: 21, 32; YBC 06231: 8; YBC 07473: 49’
^{giš}mar^{urudu} ‘shovel’
AO 07034: 8
$maš_2$ ‘goat’
$maš_2$-ḫi-a: LB 1072: 4
$maš_2$ II ‘interest’
A.26371: 2, 8; VAT 08521: 2, 3, 5
$maš_2$-bi: VAT 08521: 9, 10; YBC 04698: 2, 3, 5, 6
maš-gag-en ‘a class of persons, *muškenum’*
AUAM 73.2672: 8
$maš_2$-nin_9 ‘*nin*-goats’
AO 08464: 19
mu ‘year’
A.26371: 20; AO 06760: 63; AO 07034: 40; AO 08461: 46’; AO 08464: 39; AO 08493: 13, 18, 25, 29; AO 08524: 8, 21; Ashm 1922-277: 50; Ashm 1922-281: 38; Ashm 1922-336: 9; Ashm 1923-311: 41’; Ashm 1923: 340: 29; AUAM 73.2672: 12; LB 1072: 23; LB 1074: 22; LB 1075: 16; LB 3051: 30; NBC 05474: 12; NBC 06339: 21; NBC 06763: 19; NBC 08014: 13; Riftin 1937: no. 116: 9; YBC 04265: 17; YBC 04721: 16; YBC 05494: 20; YBC 05586: 49; YBC 06216: 16; YBC 06231: 23; YBC 07194: 21; YBC 07195: 38; YBC 07473: 6, 9, 12, 15, 36’, 44’, 50’, 63’; YBC 07744: 20; YBC 07787: 19; YBC 12273: 13
mu-bi-im ‘its name’
Ashm 1922-277: 3; Ashm 1922-281: 1; Ashm 1923-340: 5; LB 1075: 1; NBC 11509: 1; Riftin 1937: no. 116: 1; YBC 04721: 1; YBC 12273: 1
mu-ku_x(DU) ‘delivery’
A.26371: 7; AO 08464: 33; YBC 04224: 33; YBC 04224: 33; YBC 06231: 4; YBC 07194: 3
mu-ku_x(DU) II ‘delivered’
YBC 04224: 14; YBC 05494: 6, 11; YBC 05586: 5, 30; YBC 06231: 7, 13; YBC 07194: 6, 9, 14
mun ‘salt’
LB 1075: 1
munus ‘woman’
AO 08493: 30
munus lu_2 gub-ba ‘(female) ecstatic’
AO 07034: 11

N

na-gada ‘herdsman’
LB 1097: 21
na_4-dam-gar_3 ‘merchant weight’
YBC 04224: 13, 37, 40, 45, 47, 49
na_4-lugal ‘royal weight
YBC 04224: 42
nag ‘drink’
AO 07034: 31

nagar ‘carpenter’
Ashm 1924-453: 2, 14; Ashm 1924-453: 2, 14
nam-ga-eš$_8$: ‘travelling merchant’
YBC 04224: 51
nig$_2$: ‘property, things’
A.26380: 5; Ashm 1922-277: 2, 18; Ashm 1922-336: 5; Ashm 1923-340: 6, 23; Ashm 1924-453: 5, 6, 17, 18; NBC 06763: 17; Riftin 1937: no. 116: 1
nig$_2$^{meš} Ashm 1922-277: 17
nig$_2$-šu: Ashm 1922-277: 11, 25, 33, 46, 49; LB 1075: 5; LB 3051: 27; YBC 04224: 15; YBC 07744: 15
^{giš}nig$_2$ ‘bushel’
YBC 04669: 9
YBC 04669: 9
LB 1072: 11
nig$_2$-ba ‘gift’
YBC 07473: 48’
nig$_2$-ba^{meš}: YBC 07473: 57’
nig$_2$-gal$_2$-la ‘possession’
Ashm 1922-277: 47
nig$_2$-gar ‘estimated yield’
Ashm 1923-340: 5
nig$_2$-gu$_7$ ‘edible things, feed’
LB 1097: 20; YBC 07787: 2
nig$_2$-ka$_9$ ‘account’
AO 06760: 2
nig$_2$-kud ‘yield’
Ashm 1922-277: 23, 47; Ashm 1923-340: 21
nig$_2$-šu-gal ‘goods’
Ashm 1922-277: 2
niga ‘fattened’
YBC 07195: 18
ninda ‘food’
LB 1072: 7, 9
nu-banda$_3$ ‘supervisor’
Ashm 1923-340: 15
nu-tuku ‘not acquired’
YBC 05586: 26
^{gi}nun-me-šum ‘building reed’
LB 1074: 11

P

pa$_5$-sig ‘subsidiary canal’
YBC 04666: 1; YBC 07164: 15, 19

R

ra$_2$-gaba ‘messenger’
Ashm 1923-311: 37’

S

sa$_2$ ‘to be/make equal’
ib$_2$-sa$_2$: YBC 04698: 11, 21
sa$_{10}$ ‘price’
AO 07034: 6-8, 16, 19, 22, 24, 26, 28, 30, 31; Ashm 1922-336: 2; LB 1092: 1, 2, 5; NBC 08014: 2; YBC 04224: 2, 5; YBC 07195: 17; YBC 07473: 7, 28
sa$_{10}$ II ‘bought’
YBC 04698: 11
sag I ‘principal, width’
YBC 04663: 1, 3, 41, 47, 50; VAT 08521: 7, 8,10
sag-bi: YBC 04607: 2, 7, 11; YBC 04663: 42
sag-bi$_2$ la$_2$ ‘its principal checked’
LB 1075: 3
sag il$_2$-la-bi ‘difference when assessed’
YBC 04224: 10, 25
sag-nig$_2$-gur$_{11}$-ra ‘capital’
AO 06760: 11; AO 07034: 3; AO 08493: 14; LB 1075: 8; LB 3051: 1; YBC 05494: 4; YBC 05586: 4, 14, 29, 42; YBC 06231: 5; YBC 07194: 4; YBC 07195: 3; YBC 07473: 22
sag-nig$_2$-gur$_{11}$: LB 1072: 2; YBC 04721: 1
sag-nig$_2$-gur$_{11}$-ra-am: YBC 04224: 12
saḫar ‘volume’
NBC 06763: 1, 12, 14, 15; NBC 11509: 1; YBC 04607: 14, 20; YBC 04663: 1; YBC 04666: 2; YBC 07164: 17, 18
saḫar-bi: YBC 04607: 3-5, 7, 8, 12, 15, 18, 22, 23; YBC 07164: 20; YBC 12273: 1
saḫar-ḫi-a: YBC 04663: 2; YBC 04666: 3
saḫar a-gar$_3$ ‘silt’
NBC 11509: 8
santana ‘collector’
AUAM 73.2672: 6
^{tug2}sar-zum ‘a kind of garment’
YBC 07473: 40’, 55’
sig$_4$ ‘brick’
NBC 05474: 1, 9; NBC 06339: 17
YBC 04607: 1, 6
sig$_4$-al-ur$_3$-ra ‘square brick’
YBC 04607: 16, 21
siki ‘wool’
YBC 04224: 2, 5
siki-gin: AO 06760: 6; YBC 07473: 4
^{na4}sikil ‘a kind of stone’
AO 07034: 6
sila ‘street’
YBC 05494: 6; YBC 06231: 7; YBC 07194: 6

sila$_4$ 'lamb'
AO 08464: 28
sim^{ku6} 'a kind of fish'
YBC 07744: 7
simug 'metal worker'
Ashm 1924-453: 16
simug^{meš}: Ashm 1924-453: 4
sipa 'shepherd'
YBC 07195: 11
sukud 'height'
YBC 04669: 12
sukud-bi: YBC 04607: 2, 7, 11, 17, 22; YBC 04669: 11
sumun$_2$-e 'beer mash (vessel)'
LB 1091: 5

Š

ša$_3$ 'in, among'
AO 06760: 63', 64'; AO 08493: 17; AO 08524: 2, 3, 8; Ashm 1922-277: 19, 22, 41; Ashm 1922-281: 35; Ashm 1922-336: 4; LB 1069: 11; LB 1072: 1; LB 1074: 19; LB 1078: 23; YBC 05494: 2, 21; YBC 06216: 13; YBC 06231: 2, 23, 24; YBC 07194: 6; YBC 07195: 49; YBC 07473: 6, 9, 12, 15, 19; YBC 07473: 44', 50', 63'
ša$_3$-ba: Ashm 1922-277: 5, 7, 9, 13, 20, 24, 27, 34, 42, 44
ša$_3$-bi-ta 'out of which'
AO 06760: 11; AO 07034: 3; AO 08493: 14; LB 1072: 2; LB 1075: 8; LB 3051: 1; YBC 04224: 12; YBC 05494: 4; YBC 05586: 4; 14, 29, 42; YBC 06231: 5; YBC 07194: 4; YBC 07195: 3; YBC 07473: 22; YBC 07787: 8
ša$_3$-gal 'fodder'
AO 08461: 22'; Ashm 1922-281: 36; LB 1078: 13, 21; LB 1097: 16, 19; YBC 07195: 4, 18
ša$_3$-gu$_4$ 'ox driver'
LB 1074: 14
lu$_2$ ša$_3$-gu$_4$: YBC 07195: 6
ša$_3$-gu$_4$^{meš}: LB 1074: 15
ša$_3$-tam 'an official'
YBC 04224: 21
ša$_3$-tam^{meš}: Ashm 1923-340: 27; NBC 08014: 11
šag$_4$-ba 'pregnant'
AO 08493: 30
šakan$_6$ 'governor'
Ashm 1923-340: 10
še '(barley) grain'
AO 08524: 1, 4, 11, 12; AO 08461: 21', 22', 24', 38', 39', 40', 42', 48'; AO 08493: 1-3,15, 19, 22, 26, 30, 32, 34; Ashm 1922-277: 3; Ashm 1922-281: 1, 35; Ashm 1922-336: 1, 4; Ashm 1923-315: 6, 7, 8, 11, 12, 13, 16, 17; LB 1072: 1; YBC 04666: 3, 4; YBC 04721: 1; YBC 04698: 19
še-bi: Ashm 1922-277: 3; Ashm 1923-311: 3, 6, 9, 13, 16; Ashm 1923-340: 5; LB 1069: 2, 4, 6, 8; LB 1078: 4, 7, 11; Riftin 1937: no. 116: 1; YBC 4607: 13; YBC 4698: 1-4, 6
še-gur AO 06763: 1, 2; Ashm 1923-315: 1; YBC 04721: 13; YBC 05494: 1; YBC 05586: 41; YBC 06216: 1, 12; YBC 07195: 1
še-ba 'grain rations'
AO 08493: 5; AO 08524: 2, 3; YBC 07195: 6, 11, 25
še-giš-i$_3$ 'sesame'
AO 08463: 31; BC 04224: 2, 5, 15, 26, 41; YBC 04288: 5; YBC 07473: 1, 10, 13; AO 06760: 3
Ashm 1923-298: 1
še-nu 'no grain'
Ashm 1923-340: 5
še-numun 'seed-grain'
AO 08461: 4'0; LB 1097: 6, 16; YBC 07195: 4
še-sag 'flour'
A.26371: 1
šim 'perfume, perfumed oil'
AO 08464: 10
šim-ḫi-a: AO 08464; 16
šu-ku$_6$ 'fisher(man)
AO 07034: 10, 29, 32; Ashm 1922-281: 27
šu-nigin 'total'
A.26372: 34; AO 08461: 21', 42', 48'; AO 08464: 31; Ashm 1922-281: 32; Ashm 1923-311: 7, 18, 31'; Ashm 1923-315: 22; LB 1078: 22; LB 1091: 35; NBC 06763: 15; Riftin 1937: no. 116: 1; YBC 04224: 11, 25; YBC 04721: 1; YBC 07744: 13
šu-ri-a 'half'
Ashm 1922-277: 23, 47; Ashm 1923-340: 21
šu… ti 'to receive'
šu-ba-an-ti: A.26371: 6
šu-ti-a 'receipt'

AO 06760: 10, 14, 20, 23, 35, 38, 44, 57, 58; AO 08464: 36; AO 08493: 10, 25, 35; AO 08524: 18; Ashm 1923-315: 23; LB 1075: 12; LB 1092: 3, 4, 6; NBC 08014: 4; YBC 04224: 3, 6; YBC 05586: 6, 15, 17, 31, 44; YBC 07473: 21; YBC 07744: 14
$^{\text{giš}}$šu-ur$_2$-min$_3$ ‘cypress’
AO 08464: 13
šuku ‘rations’
AO 08461: 25’, 26’, 28’, 37’, 38’; Ashm 1922-277: 18; Ashm 1923-315: 5; Ashm 1924-453: 1, 5, 6, 8, 9, 13, 17, 18, 20; LB 1072: 3, 7; LB 1082: 12; LB 3051: 18
šum$_2$ ‘to give
YBC 04698: 2, 5, 9, 19

T

tab-ba-ni ‘their partners
YBC 07194: 19
tab-ba-ni$^{\text{meš}}$: YBC 04224: 23
tibira ‘metal worker’
tibira ‘metal worker’
Ashm 1922-336: 3
tug$_2$ ‘garment’
AO 07034: 7, 19
tug$_2$-ḫi-a: AO 06760: 24, 26, 53; YBC 07473: 23, 25
tug$_2$-e$_2$-a ‘sail cloth’
YBC 07473: 49’
tum$_3$ ‘to bring’
AO 08461: 32’

U

u$_4$ ‘day’
A.26371: 7; AO 06760: 62; AO 08461: 22’-26’, 36’, 45’, 46’; AO 08493: 12, 18, 21, 29; AO 08524: 8, 20; Ashm 1922-277: 50; Ashm 1922-281: 37; Ashm 1923-311: 32’, 34’, 40’; Ashm 1922-336: 8; Ashm 1923-315: 5; Ashm 1923: 340: 28; Ashm 1924-453: 12, 22; AUAM 73.2672: 11; LB 1069: 12; LB 1072: 7, 8, 22; LB 1074: 21; LB 1075: 15; LB 1078: 24; LB 1091: 36; LB 1097: 20; LB 2053: 3, 5, 7, 9, 12; LB 3051: 19, 29; NBC 06339: 20; NBC 06763: 18; NBC 11509: 11; NBC 08014: 12; Riftin 1937: no. 116: 2; YBC 04265: 16; YBC 04721: 15; YBC 05494: 19; YBC 05586: 33, 48; YBC 06216: 15; YBC 06231: 22; YBC 07164: 16-18; YBC 07194: 20; YBC 07473: 18, 62’; YBC 07744: 19; YBC 07787: 18; YBC 12273: 12
udu ‘sheep’
YBC 07473: 7
udu-nita$_2$ ‘ram
AO 06760: 33, 54; AO 08464: 18, 20, 22; YBC 07473: 7, 34
udul ‘cow herd’
YBC 07195: 11
ugu ‘top’
NBC 05474: 9; YBC 04277: 4
ugula ‘overseer’
Riftin 1937: no. 116: 1; YBC 07744: 18
ugula dam-gar$_3$ ‘merchant overseer’
A.26371: 4; YBC 04224: 38; YBC 07473: 21; YBC 07744: 16
ugula Amurru ‘overseer of the Amorites’
Ashm 1922-281: 35
ugula nam-5 ‘overseer of 5’
AUAM 73.2672: 5
$^{\text{uzu}}$ur ‘dog meat’
AO 07034: 28
ur$_2$ ‘base’
AO 07034: 16
uru$_4$ ‘to sow’
Ashm 1922-277: 5, 7, 9, 13-15, 19, 20, 23, 24, 27, 31, 34, 37, 40, 44; Ashm 1923-340: 17-19, 21
urudu ‘copper’
AO 06760: 13; AO 07034: 8
uš ‘length’
NBC 06763: 1; BC 04663: 1, 41, 42, 47, 50; YBC 07164: 15, 19; YBC 12273: 1
uš-bi: YBC 4607: 1, 6, 10; YBC 04666: 1
uš$_2$ ‘dead
Ashm 1922-277: 6, 8, 14, 29, 30
utul$_2$ ‘large bowls’
YBC 07473: 39’
utul$_2$-ḫi-a YBC 07473: 27

Z

$^{\text{giš}}$za-ba-al ‘juniper (excelsa)’
AO 08464: 12
za-e ‘you’
YBC 04663: 2, 43
$^{\text{urud}}$zabar ‘bronze’
AO 06760: 36
zag ... en-na ‘from ... until’
LB 1072: 8; LB 3051: 19
zaḫ$_2$ ‘runaway
Ashm 1922-277: 6, 8, 29
zi-ga ‘disbursement’
YBC 04224: 30
zi$_3$-ma-gaz ‘ground flour’

LB 1091: 4
zu ‘to know’
in-da-zu-de$_3$; YBC 04663: 2, 43
zu$_2$-lum ‘dates
AUAM 73.2672: 1; YBC 04224: 5; YBC 07787: 3
zu$_2$-lum-ma: YBC 04224: 2

Reading Uncertain

x x gur ku6
YBC 07744: 9
x x (x) ku6
YBC 07744: 11
li-X-um
Ashm 1923-315: 15
šu-giš-X-na
Ashm 1922-277: 1

Part II Name Index

This index lists personal names, divine names and geographic names encountered in the economic texts edited here. Geographic names are further sub-divided into building and temple names, field and garden names, gentilics and then city, town and region names.

Glosses

amar-utu = Marduk	mar-tu = Amurru	f. of = father of
en-zu = Sîn	utu = Šamaš	h. of = husband of
innin = Ištar	b. of = brother of	s. of = son of
iškur = Adad	d. of = daughter of	w. of = wife of

Personal Names

.

A

a-bi-a-a-am-ši: LB 3051: 9, 21
a-bi-e-ra-aḫ: NBC 06339: 4
a-bu-lu-mu-ur: YBC 04265: 11
a-bu-ra-bi: YBC 07195: 8
a-da-a: tibira, Ashm 1922-336: 3
^{d}Adad-ereš$_{4}$: YBC 04265: 12
^{d}Adad-*ri-ma-an-ni*: LB 1091: 12
^{d}Adad-sipa: giri$_{3}$, NBC 08014: 8
^{d}adad-*šar-rum*: Ashm 1922-281: 2
a-ḫa-mar-ši$_{2}$: *na-ap-pi*$_{2}$*-lum*, Ashm 1923-340: 11
^{I}*a-ḫi-ia*: ugula-nam 5, AUAM 73.2672: 5
a-ḫu-šu-nu: LB 3051: 4, 23, 27
a-ḫu-um: giri$_{3}$, AUAM 73.2672: 9
  f. of *ap-lum*, Ashm 1923-340: 9
a-ḫu-wa-qar: f. of *i-din-iš*$_{8}$*-tar*$_{2}$, YBC 07787: 5
f. of *i-din-*^{d}Ištar, YBC 07787: seal: 2
a-li$_{2}$*-lu-mur*: YBC 07787: 13
a-na-^{d}Ištar-*ap-qid*: giri$_{3}$, AO 08493: 21, 22
a-na-^{d}Sîn-*tak*$_{2}$*-la-ku*: LB 1091: 26
a-na-^{d}Šamaš-*tak*$_{2}$*-la-ku*: LB 1091: 25
an-na-a: f. of ^{d}nin-urta-*ga-mil*, A.26371: 16
an-ši-me$^{?}$*-ea-tum*: AO 08461: 29’, 31’
a-pil-^{d}Amurru: Ashm 1923-340: 16
a-pil-er$_{3}$*-ra*: LB 3051: 10, 11
a-pil-^{d}*ki-it-tum*: giri$_{3}$, AUAM 73.2672: 7
a-pil-ku-bi: YBC 07473: 48’
a-pil-^{d}Sîn: giri$_{3}$, YBC 07194: 16
ap-lum: LB 3051: 15
s. of *a-ḫu-um*, Ashm 1923-340: 9
aš-rum-a-ša-mar: Ashm 1922-281: 5
aš-šum-e$_{2}$-a-*ga-am*…: YBC 04265: 14
a-ta-a-a: NBC 06339: 1
a-ta-na-a-a: NBC 06339: 9
a-ta-na-aḫ-i$_{3}$*-li*$_{2}$: YBC 06216: 11
a-wi-il-^{d}adad: Ashm 1923-340: 16
a-wi-il-dingir: LB 3051: 14
a-wi-il-i$_{3}$*-li*$_{2}$: Ashm 1922-281: 3
a-wi-li-ia: NBC 06339: 6

B

ba-li-ṭa: santana, Ashm 1922-277: 35
be$_{2}$*-la-nu-um*: YBC 07787: 14
be$_{2}$*-e-ta-a*: Ashm 1923-340: 14
bur-ri-ia: NBC 06339: 16
bu-ru-um: NBC 05474: 3

D

dam-qum: giri$_{3}$, YBC 05586: 8
dingir-*ba-ni*: AO 06760: 20
  father of *u-bar-*^{d}Šamaš, AO 06760: 10
  father of *ši-ir-pu-ni-i-nu-u*$_{2}$*-ma*, AO 06760: 17

R. Middeke-Conlin, *The Making of a Scribe*, Why the Sciences of the Ancient World Matter 4, https://doi.org/10.1007/978-3-030-35951-5

^{d}Šamaš-mu…: s. of *ṣi-li-*^{d}Amurru, ir$_3$ An ^{d}Amurru, YBC 04265: sealing 1
dingir-*lam-ki-i*: LB 3051: 7, 16
dingir-*ma-a-bi*: Ashm 1923-340: 26
dingir-*šu-ba-ni*: giri$_3$, YBC 05494: 13; YBC 06231: 16
dingir-*šu-i-bi-šu*: NBC 08014: 4
dingir-*šu-ib-rum*^{ki}: Ashm 1922-281: 13
dug$_3$-*ṣi-la-šu*: YBC 07195: 10

E

e$_2$-a-*ga-mil*: f. of *si*$_2$*-si-i*, A.26371: 14
e$_2$-a-*ma-lik*: giri$_3$, Ashm 1922-281: 31
e$_2$-a-*na-ṣi-ir*: giri$_3$, YBC 06231: 17
e-ku-u$_2$*-a*: A.26371: LoE
s. of *i-din-*^{d}bil$^{?}$-gi$^{?}$, A.26371: 11
^{I} ^{d}en-lil$_2$-ma-dingir: A.26371: 5
^{d}en-lil$_2$-*na-ṣir*: Ashm 1922-281: 7
ensi$_2$-*a-pi-il-i*$_3$*-li*$_2$: Ashm 1923-311: 37’
er$_3$*-ra-ba-ni*: giri$_3$, YBC 05586: 38
e-tel-pi$_4$: santana, AUAM 73.2672: 6

G

gi-mi-lum: YBC 07473: 54’
giri$_3$, YBC 05494: 14; YBC 05586: 6, 15, 17, 31, 44; YBC 07473: 54’
gi-mil-^{d}Šamaš: LB 1091: 13
giri$_3$-i$_3$-sa$_6$: giri$_3$, YBC 04224: 23
giri$_3$-ni-i$_3$-sa$_3$: f. of *u-bar-*^{d}Šamaš, A.26371: 18

H

ḫa-ab-li-ia: Ashm 1922-281: 11
ḫa-am-mu-ra-bi: Ashm 1923-311: 41’
ḫa-zi-rum: šu-ku$_6$, AO 07034: 32
ḫu-nu-bu-um: NBC 06339: 11
ḫu-pa-tum: YBC 06216: 5
ḫu-za-lum: Ashm 1922-281: 12
ḫu-za-a-lum: LB 1091: 23
ḫu-zu-mu-um: LB 1091: 24

I

ia-da-a-a-tum: YBC 06216: 9
i-ba-aš-ši-dingir: giri$_3$, YBC 05586: 39
i-bi-e$_2$-a: YBC 04265: 13
i-bi-^{d}*šakkan*: f. of *ma-aš-rum-tu-ra-am*, Ashm 1922-281: 34
ib-na-tum: AO 06760: 20, 38, 58
i-din-^{d}bil$^{?}$-gi$^{?}$: f. of *e-ku-u*$_2$*-a*, A.26371: 12
i-din-iš$_8$*-tar*$_2$: s. of *a-ḫu-wa-qar*, YBC 07787: 4
i-din-^{d}Ištar: s. of *a-ḫu-wa-qar*, ir$_3$ ^{d}šul-pa-e$_2$, YBC 07787: seal: 1
i-din-^{d}*la-ga-ma-al*: Ashm 1922-277: 33
i-din-^{d}Sîn: šakan$_6$ *ki-ip-ra-am*^{ki}, Ashm 1923-340: 10
i-din-^{d}Šamaš: ensi$_2$, Ashm 1923-340: 7
i-ga-ia: YBC 06216: 2
i-ku-un-pi$_4$-^{d}Adad: AO 08464: 36
i$_3$*-li*$_2$*-i-di-nam*: nu-banda$_3$, lu$_2$ šu-na-nu-un-dim$_2$^{ki}, Ashm 1923-340: 15
i$_3$*-li*$_2$*-i-din-nam*: AO 08461: 37’; AO 08464: 37; Ashm 1922-290: 13; LB 1091: 19; YBC 07744: 18
i$_3$*-li*$_2$*-i-ma*…: AO 07034: 27
i$_3$*-li*$_2$*-ip-pal-sa*$_3$: dam-gar$_3^{?}$, Ashm 1922-336: 6
i$_3$*-li*$_2$*-lu-mur*: YBC 07787: 16
i$_3$*-li*$_2$-sukkal: AO 08461: 25’, 43’
i$_3$*-li*$_2$*-u*$_3$-dingir: AO 08461: 35’
i$_3$*-li*$_2$-uru-zu: YBC 04721: 6
im-gur-^{d}Sîn: NBC 05474: 1
giri$_3$, YBC 05494: 16, 17
s. of ^{d}nanna-an-dul$_3$, ir$_3$ ^{d}nin-šubur, AUAM 73.2672: sealing 1
im-gur-ušu$_3$: Ashm 1924-453: 5, 17
im-me-er-dingir: NBC 06763: 17
in-bu-ša: Ashm 1922-277: 16, 41
i-ni-…: AO 08461: 38’
i-ni-a-tum: AO 07034: 36
i-pi$_2$*-iq-*^{d}*da-gan*: giri$_3$, YBC 04224: 40
ip-qu$_2$*-iš*$_8$*-tar*$_2$: NBC 06339: 5
ip-qu$_2$*-ša*: YBC 04224: 3, 33
ir$_3$-^{d}Amurru, LB 3051: 18
ir$_3$-^{d}ba-ba$_6$: YBC 06216: 8
i-ri-ba-am-^{d}Sîn: LB 1091: 33; YBC 06216: 10
ir$_3$-^{d}nanna: AO 06760: 23, 35
giri$_3$, YBC 07195: 20
ir$_3$-^{d}Sîn: AO 06760: 65
ir$_3$-*šu-a-bu-šu*: AO 08461: 48’
is-su-na-ar-⸢x]: Ashm 1923-315: 23
iš-gu-um-er$_3$-ra: YBC 06216: 3
^{d}Ištar-HI$^{?}$.LAM$^{?}$: AO 08524: 15
^{d}Ištar-*na-aḫ-ra-ri*: giri$_3$, AO 08493: 17
^{d}Ištar-*um-mi-e-ni-iš-tim*: giri$_3$, AO 08493: 28
it-ti-^{d}Sîn-*ba-la-ṣu*: LB 1091: 22
it-ti-^{d}Sîn-*mil-ki*: AO 08464: 33
it-ti-^{d}Sîn-*mi-il-ki*: YBC 07473: 61’
ugula dam-gar$_3$ *zar-bi*$_2$*-lum*^{ki}, YBC 07473: 21
i-tur$_2$*-rum*: ugula *i*$_3$*-li*$_2$*-i-din-nam*, YBC 07744: 17

K

kab-tu-um: x of ^{d}nanna, AO 06760: 12
ki-nu-um-ḫa-bi-il: LB 1091: 28

^{d}*ki-it-tum-li-iz-zi-iz*: AO 08493: 26
ku-du-ur-ma-bu-uk: YBC 07473: 15, 50’
ku-uk-ku-lum: NBC 06339: 10

L
la-li-i-a: AO 07034: 10
li-bur-ṣi-li$_2$: LB 1091: 29
li-pi$_2$*-it-er*$_3$*-ra*: YBC 04224: 6, 33
li-pi$_2$*-iṭ-i*$_3$*-li*$_2$*-šu*: A.26371: 10, LeE
li-pi-it-iš$_8$*-tar*$_2$: AO 07034: 20
li-pi$_2$*-it-*^{d}Sîn: YBC 04721: 3
lugal-ibila: NBC 06339: 13
lu$_2$-^{d}Amurru: giri$_3$, YBC 05586: 12, 27
lu$_2$-^{d}nin-šubur-ka: giri$_3$, YBC 06231: 18
lu$_2$-^{d}nin-šubur: giri$_3$, YBC 07194: 17

M
ma-an-ni-ia: AO 08493: 10, 34
ma-a-nu-um: giri$_3$, YBC 06231: 19
b. of ^{d}Sîn-*ma-gir*, AO 08461: 28’, 41’
^{d}Marduk-*na-ṣir*: giri$_3$, Ashm 1923-340: 27
ma-aš-rum-tu-ra-am: s. of *i-bi-*^{d}*šakkan*, Ashm 1922-281: 34
ma-ti: LB 3051: 2
mu-na-wi-rum: *ba-ab-bi-lu-ut*, YBC 04265: 8
mu-ḫa-ad-du-um: LB 3051: 8
mu-na-ni: LB 1092: 4

N
na-ap-lu-us-^{d}…: Ashm 1922-281: 8
na-bi-i$_3$*-li*$_2$*-šu*: giri$_3$, AO 06760: 48; NBC 08014: 6
na-bi-^{d}Šamaš: YBC 04265: 9
ugula Amurru, Ashm 1922-281: 35
na-bu-tum: Ashm 1922-281: 6
na-mi-ra-am-ša-ru-[*ur*]: YBC 12273: 11
^{d}Nammu-*tu-kul*$_2$*-ti*: AO 08524: 3, 6
^{d}*na-na-a-la-ma-si*$_2$: LB 1082: 16
^{d}nanna-an-dul$_3$: f. of *im-gur-*^{d}Sîn, AUAM 73.2672: sealing 2
^{d}Nanna-ki-ag$_2$: NBC 05474: 5
^{d}nanna-ma-an-si$_3$: LB 1075: 5, 12; LB 1091: 15; YBC 04288: 13
giri$_3$, NBC 08014: 9; YBC 05494: 15; YBC 06231: 15
na-ra-a-a: NBC 05474: 6
na-rum-li-[*ṣi*]: Ashm 1923-340: 19
^{d}*ne*$_3$*-eri*$_{11}$*-gal-la-ma-sa*$_3$*-šu*: Riftin 1937: no. 116: 3
nig$_2$*-gi-ia*: YBC 07787: 15
Nin-ki-aĝ$_2$-^{d}iškur-ra: NBC 06763: 16
^{d}nin-urta-*ga-mil*: s. of *an-na-a*, A.26371: 15
nu-rum-li-ṣi: lu$_2$ šu-na-nu-un-dim$_2^{ki}$, Ashm 1923-340: 12
nu-ur$_2$-^{d}*a-ba*: YBC 04224: 48
nu-ur$_2$-^{d}*a*$_2$*-ḫe*$_2$: YBC 04721: 4
nu-ur$_2$-^{d}Amurru: giri$_3$, YBC 06231: 20
nu-ur$_2$*-i*$_3$*-li*$_2$*-šu*: giri$_3$, AO 08493: 31
nu-ur$_2$*-i*$_3$*-li*$_2$*-a*: NBC 05474: 7
nu-ur$_2$-^{d}Ištar: AO 08461: 6
nu-ur$_2$-^{d}Ištar-tuk: Ashm 1922-281: 15
nu-ur$_2$*-ra-ṭum*: NBC 06339: 8
nu-ur$_2$-^{d}Sîn: NBC 06339: 14
nu-ur$_2$-^{d}Šamaš: AO 07034: 17

P
pa-la-šu-li-ri-ik: AO 07034: 5
pi-ir-ḫu-um: YBC 07787: 5
pir-ḫu[*-um*]: YBC 08271: 8
pi-iš-ti-ia: AO 08493: 25; AO 08524: 18
pu-ḫa-bi-li: LB 1091: 11
pu-uṭ-ra-am-i$_3$*-li*$_2$: YBC 06216: 6

R
ri-ib-di-*i-ša*: w. of *si-im-mu-ug-ra*, AO 06760: 41
^{d}*ri-im-*^{d}Sîn: Ashm 1922-281: 38; Ashm 1922-336: 9; Riftin 1937: no. 116: 11; YBC 04721: 16; YBC 07473: 9, 36’
ri-im-^{d}Sîn-*i*$_3$*-li*$_2$: LB 1091: 17
^{d}ri-im-^{d}Sîn-*ra-ap-pa-šu-nu*: NBC 11509: 10; Riftin 1937: no. 116: 2

S
sa$_3$*-ak-ni-ia*: NBC 06339: 3
sa-am-su-i-lu-na: AUAM 73.2672: 12
sa$_3$*-si*$_2$*-ia*: NBC 06339: 13
si-mu-ug$_2$*-ra*: AO 07034: 9;
h. of *ri-ib*-di-*i-ša*, AO 06760: 41
^{d}Sîn-…: Ashm 1923-340: 17
^{d}Sîn-dam-gar$_3$-*ri*: Ashm 1923-340: 13
^{d}Sîn-ereš$_4$: YBC 04224: 46; YBC 07195: 9
lu$_2$ umma^{ki}, YBC 05586: 7
^{d}Sîn-*ip-ṭu*$_2$*-ra-am*: LB 3051: 20
^{d}Sîn-*i-ri-ba-am*: YBC 06216: 4
^{d}Sîn-*iš-me-a-ni*: NBC 05474: 4
^{d}Sîn-*i-te-er*: AO 07034: 12
^{d}Sîn-*i-din-nam*: YBC 05494: 22
^{d}Sîn-*ma*-dingir: LB 1092: 3, 6
^{d}Sîn-*ma-gir*: AO 07034: 4; Ashm 1923-340: 14; YBC 07195: 35
b. of *ma-a-nu-um*, AO 08461: 28’, 41’
^{d}Sîn-*mu-ba-li*$_2$*-iṭ*: nam-ga-eš$_8$, YBC 04224: 50
^{d}Sîn-*mu-pa-ḫi-ir*: AO 06760: 14; AO 07034: 35
^{d}Sîn-*mu-uš-ta-al*: ugula-dam-gar$_3$ uri$_2^{ki}$, YBC 07744: 15
^{d}Sîn-*ni-šu*: LB 1091: 16

^{d}Sîn-*ra-bi*: LB 1091: 31
^{d}Sîn-*ra-ma*: AO 08493: 5, 11, 15, 32, 35; AO 08524: 2, 5
^{d}Sîn-*ri-ma-an-ni*: LB 1091: 14
^{d}Sîn-sipa: AO 07034: 18, 19; Ashm 1923-340: 13
^{d}Sîn-*šar-ma-tim*: AO 07034: 7
^{d}Sîn-*tu-ra-am*: LB 1091: 18
si$_2$*-si-i*: s. of e$_2$-a-*ga-mil*, A.26371: 13
su-mu-e-mu-ut-ba-lim: giri$_3$, NBC 08014: 5

Ṣ
ṣi$_2$*-bu-ru*-ir$_3$: Ashm 1922-277: 46
ṣi-li-[…]: Ashm 1923-340: 18
ṣi-li$_2$-^{d}Ištar: LB 1091: 32
ṣi-li$_2$-iš$_8$-tar$_2$: giri$_3$, AO 06760: 44; AO 07034: 8, 32
ṣi-li-^{d}Amurru: f. of ^{d}Šamaš-mu…YBC 04265: sealing 2
ṣi-li-^{d}Šamaš: YBC 06231: 4; YBC 07194: 3
ṣi-li$_2$-^{d}Šamaš: AO 06760, 57
giri$_3$, YBC 05586: 12, 27

Š
ša-ma-a-a-tum: LB 3051: 12
^{d}Šamaš-*aš-šu-ap-lu*: YBC 04721: 9, 14
^{d}Šamaš-e$_3$-a: Ashm 1923-311: 38’
^{d}Šamaš-*ḫa-zi-ir*: giri$_3$, Ashm 1923-340: 27
^{d}Šamaš-*ki-ma*-engar: YBC 04721: 7
^{d}Šamaš-palil: NBC 08014: 7
^{d}Šamaš-*ša-ta-ka-lim*: Ashm 1923-311: 29’, 34’
^{d}Šamaš-*tu-ra-am*: Ashm 1923-311: 30’, 36’
^{d}Šamaš-*ub-lam*: AO 07034: 14
šar-ru-ut-^{d}Sîn: giri$_3$, YBC 06231: 21
ugula dam-gar, A.26371: 4
še-rum-ba-ni: AO 07034: 33
ši$_4$*-im-ti-iš-ša-an*: YBC 07473: 31
ši-ri-a-a-bi: LB 1091: 21
ši-ir-pu-ni-i-nu-u$_2$*-ma*: d. of dingir-*ba-ni*, AO 06760: 17
šu-^{d}ba-ba$_6$: LB 2053: 15
^{d}šul-pa-e$_3$-na-ṣir: dam-gar$_3$, Ashm 1922-336: 5
šum-ma-an-la-^{d}Ištar: LB 1091: 27
šu-mu-li-ib-ši: Ashm 1922-281: 9
šu-^{d}*na-zi*: NBC 05474: 2
šu-nu-u$_2$*-ma*-dingir: YBC 04265: 10
šu-ta: LB 3051: 3
šu-uk-ma-an-ṣi-ir: man of, AO 07034: 13

T
ta-ri-ba-tum: LB 1092: 5
ta-ri-bu-um: LB 1091: 10

Ṭ
ṭa$_3$*-ab-*…: Ashm 1922-281: 17

U
u-bar-^{d}Šamaš: AO 06760: 60
giri$_3$, AO 06760: 52
s. of dingir-*ba-ni*, AO 06760: 10
s. of giri$_3$-ni-i$_3$-sa$_3$, A.26371: 17
u-bar-rum: giri$_3$, YBC 05494: 16
ur$_2$…: AO 08461: 18’-20’
ur-^{d}asar-lu-ḫi: NBC 06339: 2
^{d}*uraš-mu-ba-li*$_2$*-iṭ*: Ashm 1922-277: 11, 14, 31
ur-^{d}nanna: AO 06760: 56; YBC 07473: 48’
ur-^{d}nin-a-zu: of uru^{ki} ^{d}*Sîn-šar-ma-tim*, YBC 04224: 43
ur-^{d}šu-bu-la: NBC 06339: 15
u$_2$*-ṣi-nu-rum*: giri$_3$, maš-gag-en, AUAM 73.2672: 8
ušu$_3$-apin: Ashm 1923-340: 26
ušu$_3$-*im-gur-an-ni*: Ashm 1922-281: 4
ušu$_3$-*ṣi-nu-šu*: giri$_3$, NBC 08014: 10
u$_2$*-ta-a-a*: NBC 06339: 7

W
wa-tar-^{d}Šamaš: AO 08461: 44’
ugula-nam 5, YBC 07744: 14

Z
^{d}*za-ba*$_4$*-ba*$_4$*-mu-ša-lim*: YBC 06216: 7
^{d}*za-ba*$_4$*-ba*$_4$*-na-ṣir*: dub-sar, Ashm 1922-277: 10
zi-kir-i$_3$*-li*$_2$*-šu*: AO 08493: 20; Ashm 1922-277: 16
zi-nu-u$_2$: AO 08493: 30

Divine Names
^{d}Adad: YBC 07194: 21
^{d}Amurru: YBC 04265: sealing 3
An: LB 1072: 23; Riftin 1937: no. 116: 8; YBC 04265: sealing 3
e$_2^{?}$-a: AO 07034: 31
^{d}en-ki: NBC 06763: 20; Riftin 1937: no. 116: 8
^{d}en-lil$_2$: LB 1072: 23; Riftin 1937: no. 116: 8
^{d}Ištar: AO 07034: 11; YBC 07473: 57’
^{d}Marduk: Ashm 1923-311: 42’
^{d}nanna: AO 06760: 12, 34; Ashm 1922-277: 41, 48; Ashm 1923-340: 20
^{d}ne$_3$-eri$_{11}$-gal: Riftin 1937: no. 116: 7; YBC 08758: 6
^{d}nin-šubur: AUAM 73.2672: sealing 3
^{d}Šamaš: YBC 07787: 20

^{d}šul-pa-e$_2$: YBC 07787: sealing 3
^{d}taš-me-tum: YBC 07744: 20

Geographic Names

.

Building and Temple Names

abul ^{d}uraš: YBC 04288: 10
e$_2$ ^{d}Adad: AO 06760: 63; Ashm 1924-453: 10, 21; YBC 07473: 12, 44’
e$_2$ ^{d}bara$_2$-ul-e$_2$-gar-ra: *zar-bi$_2$-lum*^{ki}: AO 06760: 64; YBC 05494: 20
e$_2$ ^{d}en-ki: YBC 06231: 23, YBC 07473: 63’
e$_2$ gal-bar-ra: AO 06760: 65
e$_2$ ^{d}Ištar: YBC 07473: 18, 63’
e$_2$ mes-lam: A.26371: 20
e$_2$ me-te-ur-sag: YBC 04265: 17
e$_2$ ^{d}nanna: Ashm 1922-277: 2, 34, 37; YBC 07473: 16; 18, 50’, 63’
e$_2$ ^{d}nin-ga$_2$-nu-ur$_2$: YBC 07473: 6
e$_2$ ^{d}nin-inim-ma: YBC 06231: 24
e$_2$ ki-gal-$_2$ gibil sila-dagal-la gibil: YBC 07194: 6
e$_2$ kišib-ba e$_2$ sila dagal-la gibil: YBC 05494: 6
e$_2$ kišib-ba e$_2$ sila-gid$_2$-da gibil: YBC 06231: 7
e$_2$ dingir-re-e-ne: AO 08493: 16
e$_2$ ^{d}nanna: Ashm 1922-277: 2, 34, 37; Ashm 1923-340: 2, 6, 23
e$_2$ sikil-li: AO 08493: 4
e$_2$ ^{d}Šamaš: YBC 05586: 49
guru$_7$ e$_2$ ^{d}Šamaš: YBC 05586: 5, 30, 35, 43

Field and Garden Names

a-gar$_3$ a-a-ni-a-tum: Ashm 1923-340: 1, 25
a-ša$_3$ *a-ga-ak-kum*: LB 1074: 19
a-gar$_3$ dam-la-ga-nu: Ashm 1923-340: 1, 25
a-ša$_3$ *ḫa-za-za-nu-um*: LB 1069: 11; LB 1078: 23
a-ša$_3$ *mu-ḫa-al-lu-u$_2$*: YBC 07195: 28
a-ša$_3$ *mu-uš-ta-al*: AO 08461: 27’
a-ša$_3$ šuš$_4$-ḫi-li: AO 08461: 39’

Water Names

gu$_2$ idigna: Ashm 1923-311: 45’
i$_7$ ^{d}en-⸢lil$_2$⸣[…]: NBC 06763: 14
i$_7$ gu$_3$-nun-di: AO 08464: 39
i$_7$ lagaš^{ki}: YBC 06216: 16
i$_7$ *ma-lik-er$_3$-ra*: NBC 06763: 12
i$_7$ ^{d}ma-mi-*šar-ra-at*: NBC 11509: 9
i$_7$ *ri-bi-an-na*: Ashm 1923-340: 4
i$_7$ ug-gim-du: Ashm 1923-311: 38’
i$_7$ i$_3$-si-in^{ki}: NBC 05474: 10; NBC 06339: 12

Gentilics

dumu^{meš} *si-im-mu-ug-ra*: AO 07034: 9
erin$_2$ Amurru: YBC 04224: 16, 18
erin$_2$ elam^{ki}: Ashm 1922-281: 16
erin$_2$ larsa^{ki}: Ashm 1922-281: 29
erin$_2$ uru ^{d}gu-la: Ashm 1922-281: 30
erin$_2$ uru *ša-aš$_2$-rum*: Ashm 1922-281: 30
lu$_2$ bad$_3$-tibira^{ki}: YBC 04224: 8, 34
lu$_2$ elam-ma^{ki}: AO 08461: 26’
lu$_2$ Maškan-šapir (maš-kan$_2$-šabra^{ki}): AO 07034: 4
lu$_2$ *šu-uk-ma-an-ṣi-ir*$^{?}$: AO 07034: 13
lu$_2$ šu-na-nu-un-dim$_2^{ki}$: Ashm 1923-340: 12, 15
lu$_2$ umma^{ki}: YBC 05586: 7

City, Town and Region Names

Adab^{ki}: Riftin 1937: no. 051: 17; YBC 05494: 21; YBC 07195: 39; YBC 07310: 20
an-za-gar$_3$ bala-mu-nam-ḫe$_2$: YBC 06231: 2
aš-dub-ba^{ki}: AO 08493: 6; AO 08524: 9
bad$_3$-an^{ki}: YBC 07473: 33
bad$_3$-tibira^{ki}: YBC 07195: 21
e$_2$-duru$_5$ i$_3$-sa$_3$^{ki}: NBC 06339: 21
e$_2$ ^{d}nin.mar^{ki}: YBC 06231: 24
eš$_3$-nun-na$^{(ki)}$: Ashm 1923-311: 43’; NBC 08014: 12; YBC 12273: 13
im^{ki}: YBC 07194: 21
i$_3$-si-in^{ki}: AO 08493: 35; AO 08524: 8, 21; AO 07034: 12, 40; LB 1072: 24; LB 1075: 16; Riftin 1937: no. 116: 9
i$_3$-si-in-na$^{(ki)}$: LB 1074: 22; NBC 06763: 19
ki ^{d}Šamaš-e$_3$-a: Ashm 1923-311: 38’
ki-ip-ra-am^{ki}: Ashm 1923-340: 10
larsa^{ki} (ud-unug^{ki}): AO 06760: 63; AO 08493: 9, 17; Ashm 1922-281: 27; YBC 04721: 2; YBC 05494: 23; YBC 07473: 12, 18, 44’
ma$_3$-al-gi-a^{ki}: Ashm 1923-340: 30
ma-an-ki-sum$_2$: Ashm 1923-311: 45’
ma$_2$-ri$_2$^{ki}: Ashm 1922-277: 50; Ashm 1923-340: 30
maš$_3$-gan$_2$-šabra^{ki}: YBC 07473: 6
nir-da^{ki}: Ashm 1922-277: 2, 32, 45
su-bir$_4$^{ki}: Ashm 1923-311: 46’
tin-tir^{ki}: AO 07034: 41
ud-kib-nun^{ki}: YBC 07787: 19
um-ma^{ki}: LB 1097: 21
unug^{ki}: AO 07034: 40; AO 08493: 16, 22
uri$_2$^{ki} (šeš-unug^{ki}): YBC 04721: 2; YBC 06231: 23; YBC 07744: 16
uru^{ki} *a-bi-sa-re-e*: YBC 07195: 32
uru^{ki} *di-la-a-nu-um*: YBC 04224: 19

uru^{ki} *di-ni-ik-tum*: LB 1075: 6, 9, 10
uru^{ki} e$_2$-maḫ: AO 08461: 30’
uru^{ki} eš$_3$-nun-na^{ki}: LB 1075: 2
uru^{ki} *i-di-*^{d}uraš: YBC 05586: 40
uru^{ki} *iš-ku-un-*e$_2$-a: YBC 07195: 27
uru^{ki} KA-AN^{ki}: YBC 05494: 2
uru *kur-ḫi-a-nu*^{ki}: Ashm 1922-277: 2, 38, 48
uru^{ki} MAŠ$_2$-ZI: YBC 05586: 13, 28
uru^{ki} *me-du-u$_2$-um*: YBC 04224: 17
uru^{ki} *ra-ḫa-bu-um*: AO 07034: 5; YBC 04224: 43
uru^{ki} ^{d}Sîn-*nu-ur$_2$-ma-tim*: YBC 07194: 1
uru šu-un-na-mu-un-dim$_2^{ki}$: Ashm 1923-340: 3, 26
zabalam^{ki}: YBC 07473: 57’
zar-bi$_2$-lum^{ki}: *AO 06760: 64; YBC 07473: 21, 33*
za-unug^{ki}: AO 07034: 11

Part III Economic Text Index

Economic texts cited or edited in this volume are listed here. Museum numbers in bold represent a text edited in this volume, either in transliteration, translation or both. Note: Index entries represent Museum number — Primary publication.

A

A.26371 — Stol 1982: no. 37, 65–67, 139, 145, 146, 178, 180–182, 184, 253, 254, 260, 368, 381, 382

A.26372 — Stol 1982: no. 34, 146

A.26378 — Stol 1982: no. 38, 74, 145, 146, 152, 154, 173, 178, 384, 385

A.26380 — Stol 1982: no. 33, 146

AO 06353 — Jean 1926: no. 010, 373

AO 06371 — Jean 1926: no. 033, 373, 374

AO 06379 — Jean 1926: no. 005, 384

AO 06734 — Dossin 1933: no. 001, 84, 85

AO 06760 — Jean 1926: no. 017, 24, 25, 75, 87–89, 92, 107, 109, 186–188, 191, 192, 261, 309, 357, 361, 362, 364, 408, 428, 431

AO 06763 — Jean 1926: no. 028, 76, 85–88, 90–92, 158–160, 305, 363, 429, 430

AO 06770 — Dossin 1934: no. 154, 184

AO 07034 — Jean 1926: no. 039, 23, 24, 75, 92, 236, 237, 264, 363, 364, 367, 411, 429, 432, 434–436, 438, 439

AO 07035 — Jean 1926: no. 045, 107, 109, 412

AO 08460 — Jean 1926: no. 064, 357

AO 08461 — Jean 1926: no. 115, 34, 70, 71, 200, 220, 227, 242, 243, 265, 376, 429, 433–435, 437, 438

AO 08463 — Jean 1926: no. 078, 111–114, 413

AO 08464 — Jean 1926: no. 072, 23–25, 27, 31, 72, 73, 111–114, 118, 187, 188, 250, 267, 357, 412, 428, 433

AO 08468 — Jean 1926: no. 100, 357, 375, 414, 416

AO 08469 — Jean 1926: no. 057, 357

AO 08475 — Jean 1926: no. 123, 408

AO 08479 — Jean 1926: no. 056, 357, 412

AO 08481 — Jean 1926: no. 054, 357, 411

AO 08486 — Jean 1926: no. 104, 375

AO 08492 — Jean 1926: no. 124, 375

AO 08493 — Jean 1926: no. 107, 75, 77, 155, 156, 162, 181–184, 253, 254, 269, 297, 374–376, 429, 431

AO 08497 — Jean 1926: no. 061, 357

AO 08500 — Jean 1926: no. 053, 357

AO 08505 — Jean 1926: no. 127, 375

AO 08506 — Jean 1926: no. 060, 357

AO 08512 — Jean 1926: no. 109, 375

AO 08522 — Jean 1926: no. 106, 375, 414

AO 08524 — Jean 1926: no. 103, 72, 239–241, 271, 375, 376, 429, 433–435, 437–439

Ashm 1922-277 — Dalley 2005: no. 006, 25, 26, 64, 97, 98, 131, 132, 134, 135, 252, 253, 312, 349, 350, 378

Ashm 1922-279 — Dalley 2005: no. 008, 381

Ashm 1922-281 — Dalley 2005: no. 010, 31, 35, 63, 64, 92, 94, 96, 99, 200, 218, 219, 226, 235, 317, 358, 359, 370, 428, 432–436, 438, 439

Ashm 1922-290 — Dalley 2005: no. 018, 26, 63, 93, 94, 96, 204, 213, 215, 234, 235, 253, 387, 430, 432, 434–437, 439

Ashm 1922-291 — Dalley 2005: no. 019, 372

Ashm 1922-300 — Dalley 2005: no. 025, 358, 359, 379

Ashm 1922-303 — Dalley 2005: no. 028, 355

Ashm 1922-306 — Dalley 2005: no. 031, 381

Ashm 1922-316 — Dalley 2005: no. 041, 360

Ashm 1922-325 — Dalley 2005: no. 050, 418

Ashm 1922-330 — Dalley 2005: no. 055, 381

R. Middeke-Conlin, *The Making of a Scribe*, Why the Sciences of the Ancient World Matter 4, https://doi.org/10.1007/978-3-030-35951-5

Ashm 1922-336 — Dalley 2005: no. 061, 65–67, 142, 272, 360, 361, 408
Ashm 1922-337 — Dalley 2005: no. 062, 360, 418
Ashm 1922-338 — Dalley 2005: no. 063, 381
Ashm 1923-057 — Dalley 2005: no. 087, 416
Ashm 1923-058 — Dalley 2005: no. 087 tablet and case, 381
Ashm 1923-298 — Dalley 2005: no. 101, 381, 430, 432
Ashm 1923-311 — Dalley 2005: no. 106, 97, 236, 237, 272, 312, 349, 377, 378, 430, 432, 434, 436, 437, 439
Ashm 1923-315 — Dalley 2005: no. 108, 200, 220, 227, 275, 386, 408, 427, 433
Ashm 1923-329 — Dalley 2005: no. 115, 353
Ashm 1923-340 — Dalley 2005: no. 121, 25, 26, 63, 97, 98, 131–135, 139, 221, 227, 229, 238–241, 252, 253, 312, 320, 349, 350, 378, 384, 430–432, 434, 435, 437, 439
Ashm 1923-374 — Dalley 2005: no. 133, 384
Ashm 1924-453 — Dalley 2005: no. 147, 3, 67–69, 71, 114, 116–118, 276, 387
Ashm 1924-454 — Dalley 2005: no. 148, 353
Ashm 1932-378 — Dalley 2005: no. 257, 186, 235, 367, 368, 429, 432, 434, 438, 439
AUAM 73.2672 — Sigrist 1990: no. 074, 65–67, 103, 104, 106, 107, 117, 186, 277, 385, 415

B
BM 016391 — Robson 2014: oracc.museum.upenn.edu/obta/P412463/html, 93, 212, 213, 215, 226

C
CBS 07110 — Robertson 1984: 186-87, 95

E
Erm — Riftin 1937: no. 001, 384
Erm — Riftin 1937: no. 017, 379
Erm — Riftin 1937: no. 025, 88
Erm — Riftin 1937: no. 033, 379
Erm — Riftin 1937: no. 051, 76, 85, 88, 90–92, 159, 160, 174, 355, 356, 363, 428, 431
Erm — Riftin 1937: no. 052, 70–72, 87, 88, 91, 355–356, 361
Erm — Riftin 1937: no. 054, 76, 85–87, 91, 92, 158–160, 305, 363, 364, 429, 430
Erm — Riftin 1937: no. 066, 355, 361
Erm — Riftin 1937: no. 114, 24, 31, 63, 92, 94–96, 99, 200, 215, 218, 253, 331, 349, 350, 358, 368–370, 429, 431
Erm — Riftin 1937: no. 115, 31, 64, 94, 95, 99, 200, 349, 350, 368–370
Erm — **Riftin 1937: no. 116**, 24, 31, 32, 63, 92, 94–96, 99, 200, 204, 215–219, 225, 226, 228, 253, 331, 349, 350, 358, 368–370
Erm — Riftin 1937: no. 117, 93, 212, 213, 215, 226

H
HE 111 — Scheil 1918: 191, 72, 74, 139, 186, 187, 368, 381, 382, 415
HS 2039 — Goddeeris 2016: no. 173, 95
HS 2197 — Goddeeris 2016: no. 048, 380
HS 2246 — Goddeeris 2016: no. 052, 380

I
IM 81438 — Biggs and Postgate 1978: no. 519, 32

L
LB 1036 — Leemans 1964: no. 03, 375
LB 1069 — Leemans 1964: no. 41, 70, 97, 200, 221, 239–241, 278, 281, 372, 420, 429, 433, 434, 436–439
LB 1072 — Leemans 1964: no. 30, 75, 77, 238–241, 279, 370, 429, 433–435, 437–439
LB 1074 — Leemans 1964: no. 43, 70, 97, 105–107, 117, 126–128, 134, 219, 127, 200, 219, 221, 226, 227, 278–280, 282, 283, 350, 371, 418, 429, 432
LB 1075 — Leemans 1964: no. 55, 64, 74, 75, 78, 79, 142, 151–154, 172, 178, 184, 234, 235, 240, 242, 246, 253, 254, 297, 324, 373, 374, 429, 432, 434, 435, 437, 439
LB 1078 — Leemans 1964: no. 42, 70, 97, 105–107, 110, 117, 200, 219, 221, 226, 227, 278, 280, 282, 350, 371, 419
LB 1082 — Leemans 1964: no. 31, 75, 77, 78, 370
LB 1083 — Leemans 1964: no. 32, 373, 374
LB 1086 — Leemans 1964: no. 65, 412
LB 1088 — Leemans 1964: no. 56, 414
LB 1091 — Leemans 1964: no. 47, 67–69, 71, 115–117, 283, 284, 354, 373, 374
LB 1092 — Leemans 1964: no. 61, 67–69, 71, 107, 109, 114, 116–118, 285, 354, 408
LB 1097 — Leemans 1964: no. 46, 24–26, 59, 98, 115–117, 130, 131, 134, 135, 243, 244, 286, 388
LB 1098 — Leemans 1964: no. 44, 289
LB 1837 — Leemans 1964: no. 64, 358, 359, 379

LB 2051 — Leemans 1964: no. 22, 373, 374
LB 2052 — Leemans 1964: no. 48, 373, 374
LB 2053 — Leemans 1964: no. 45, 34, 242, 289, 371
LB 2056 — Leemans 1964: no. 57, 373, 374
LB 2073 — Leemans 1964: no. 49, 373, 374
LB 3051 — Leemans 1964: no. 68, 75, 77, 235, 246, 290, 377, 429, 432, 434, 436–439

M
MAH 15886+16295 — Clevenstine 2015, 349, 350, 368–370

N
NBC 05410 — Alexander 1943: no. 108, 238, 352
NBC 05474 — Alexander 1943: no. 153, 60, 68, 69, 92, 236–238, 240, 253, 259, 291, 352, 427, 432, 433, 435, 436, 438, 439
NBC 05506 — Alexander 1943: no. 110, 238, 352
NBC 06339 — Walters 1970: no. 44, 60, 62, 64, 68, 69, 92, 235, 237, 238, 253, 292, 352, 377, 427, 428, 432–437, 439
NBC 06763 — Middeke-Conlin 2018: 291, 25, 26, 63, 93–96, 200–202, 211, 213–215, 225, 226, 228, 234, 235, 240, 251, 253, 257, 327, 372, 373, 387, 429, 432
NBC 08014 — Simmons 1978: no. 290, 24, 25, 65, 66, 107, 109, 186, 187, 191, 192, 194, 195, 224, 241, 242, 250, 254, 255, 293, 353, 354, 408, 428, 433–438
NBC 09050 — Walters 1970: no. 099, 60, 68, 69, 92, 238, 253, 352
NBC 11509 — Middeke-Conlin 2018: 291, 25–27, 60, 61, 63, 92, 94–96, 200, 201, 204, 211, 214, 215, 221, 225, 226, 228, 251, 327, 330, 331, 349, 350, 358, 368, 369, 372, 373

U
UET 5, 589 — Figulla and Martin 1953: no., 317
UET 5, 857 — Figulla and Martin 1953: no., 317
UET 5, 883 — Figulla and Martin 1953: no., 317

V
VAT 08408 — Klengel 1973: no. 100, 382

Y
YBC 04201 — Faust 1941: no. 128, 384
YBC 04224 — Simmons 1978: no. 164, 27, 33, 75–77, 177, 121–127, 130, 134–137, 140, 142, 145–147, 150–152, 155, 172, 186, 191–193, 195, 213, 224, 229, 234, 235, 240, 251, 253, 257, 293, 296, 351, 408, 427, 431–433, 435, 436, 438
YBC 04235 — Simmons 1978: no. 349, 351
YBC 04241 — Stol 1982: no. 12, 146, 415
YBC 04244 — Stol 1982: no. 14, 146
YBC 04264 — Stol 1982: no. 08, 382
YBC 04265 — Stol 1982: no. 29, 34, 145, 146, 152–154, 173, 178, 184, 253, 254, 296, 297, 379
YBC 04275 — Grice 1919: no. 131, 355
YBC 04277 — Stol 1982: no. 25, 146
YBC 04288 — Stol 1982: no. 28, 146
YBC 04299 — Stol 1982: no. 11, 414
YBC 04333 — Stol 1982: no. 31, 146
YBC 04335 — Faust 1941: no. 096, 384
YBC 04376 — Faust 1941: no. 021, 384
YBC 04458 — Grice 1919: no. 113, 373, 374
YBC 04470 — Stol 1982: no. 27, 145, 146, 152, 154, 173, 178, 383, 430, 431
YBC 04721 — Grice 1919: no. 103, 24, 63, 64, 74, 75, 77, 92, 94, 96, 334, 358
YBC 04730 — Grice 1919: no. 079, 411
YBC 04740 — Grice 1919: no. 102, 355
YBC 04747 — Grice 1919: no. 004, 355
YBC 04751 — Grice 1919: no. 106, 360
YBC 04761 — Grice 1919: no. 154, 72, 73, 147, 353
YBC 04797 — Grice 1919: no. 095, 107, 109, 414
YBC 04827 — Grice 1919: no. 022, 353
YBC 04828 — Grice 1919: no. 087, 107, 109, 110, 416
YBC 05087 — Faust 1941: no. 136, 360
YBC 05397 — Feigin 1979: no. 167, 382, 383
YBC 05418 — Grice 1919: no. 163, 110, 417
YBC 05494 — Grice 1919: no. 168, 24, 76, 85, 86, 91, 92, 157–160, 238–241, 299, 355, 363, 373, 374, 428, 431, 433–436, 438
YBC 05517 — Faust 1941: no. 002, 353
YBC 05568 — Grice 1919: no. 186, 364
YBC 05580 — Grice 1919: no. 182, 76, 85, 86, 88–92, 159, 160, 364, 365, 429, 430
YBC 05584 — Grice 1919: no. 145, 357
YBC 05586 — Grice 1919: no. 166, 62–64, 72, 76, 79, 84–86, 88, 89, 91, 92, 300, 355, 356, 364–366, 428, 431

YBC 05676 — Faust 1941: no. 035, 384
YBC 05680 — Faust 1941: no. 038, 384
YBC 05709 — Grice 1919: no. 122, 373
YBC 05723 — Faust 1941: no. 069, 353
YBC 05726 — Grice 1919: no. 127, 357
YBC 05733 — Faust 1941: no. 017, 384
YBC 05768 — Grice 1919: no. 188, 70, 71, 85, 87, 90, 366, 429, 432
YBC 05793 — Grice 1919: no. 203, 411
YBC 05814 — Grice 1919: no. 221, 412
YBC 05829 — Grice 1919: no. 174, 70, 71, 85, 87–89, 91, 92, 361, 362, 364
YBC 05855 — Faust 1941: no. 042, 355
YBC 06107 — Stol 1982: no. 15, 146
YBC 06143 — Grice 1919: no. 171, 364
YBC 06147 — Grice 1919: no. 126, 353
YBC 06153 — Grice 1919: no. 123, 353
YBC 06216 — Grice 1919: no. 189, 70, 71, 83, 85, 87, 103, 104, 106, 117, 237, 302, 366, 429, 433
YBC 06231 — Breckwoldt 1995/1996: 82-3, 76, 85, 86, 88, 90, 91, 92, 158–160, 303, 364, 365, 373, 374, 429, 431
YBC 06306 — Faust 1941: no. 026, 358, 359, 379
YBC 06663 — Breckwoldt 1995/1996: 84, 76, 85, 86, 90–92, 159, 160, 363, 428, 430
YBC 06745 — Faust 1941: no. 049, 384
YBC 06746 — Feigin 1979: no. 113, 382, 383
YBC 06985 — Grice 1919: no. 185, 76, 85, 86, 91, 92, 159, 160, 363, 428, 430
YBC 07076 — Grice 1919: no. 148, 373
YBC 07099 — Grice 1919: no. 218, 355
YBC 07183 — Grice 1919: no. 219, 235, 368, 429, 432, 434, 436, 438, 439
YBC 07185 — Grice 1919: no. 172, 364
YBC 07187 — Grice 1919: no. 169, 76, 85, 86, 91, 92, 159, 160, 350, 362, 428, 431
YBC 07190 — Grice 1919: no. 191, 364
YBC 07194 — Breckwoldt 1995/1996: 87, 76, 90, 160, 178, 252, 304, 364, 365, 428, 431
YBC 07195 — Grice 1919: no. 175, 62, 64, 66-68, 85, 86, 89–92, 145, 146, 152, 155–159, 172–174, 226, 272, 305, 363, 364, 418, 429, 431
YBC 07211 — Grice 1919: no. 181, 70, 71, 85, 87, 88, 90, 91, 160, 305, 364, 366
YBC 07227 — Grice 1919: no. 129, 88
YBC 07261 — Grice 1919: no. 217, 355
YBC 07308 — Grice 1919: no. 187, 85, 87, 366
YBC 07310 — Grice 1919: no. 170, 76, 85, 86, 91, 92, 159, 160, 350, 362, 428, 430
YBC 07313 — Grice 1919: no. 195, 83, 85, 87, 302, 366
YBC 07473 — Grice 1919: no. 207, 24, 25, 73, 75, 91, 107, 109, 124, 186, 188, 191, 195–199, 224, 225, 231, 234, 241, 242, 246–250, 254, 255, 257, 261, 263, 307, 355–357, 361, 409, 428, 433–436, 438
YBC 07477 — Grice 1919: no. 202, 409
YBC 07708 — Faust 1941: no. 081, 355
YBC 07744 — Stol 1982: no. 22, 72, 74, 82, 105–107, 117, 186–191, 309, 382, 383, 415
YBC 07787 — Stol 1982: no. 20, 65–67, 105, 106, 117, 139, 311, 385
YBC 08747 — Grice 1919: no. 238, 384
YBC 08748 — Grice 1919: no. 237, 411
YBC 08758 — Grice 1919: no. 178, 70, 71, 234, 235, 238, 355, 356, 410, 428, 432, 434–436, 438, 439
YBC 08759 — Grice 1919: no. 144, 373
YBC 08761 — Grice 1919: no. 176, 364
YBC 08774 — Grice 1919: no. 209, 76, 85, 86, 88, 91, 92, 159, 365, 366, 429, 431
YBC 10586 — Stol 1982: no. 16, 146
YBC 12273 — Middeke-Conlin Forthcoming b: no. 22, 25, 26, 63, 93–96, 116–118, 200, 206–209, 211, 213, 214, 216, 221, 225, 226, 228, 251, 253, 254, 256, 337, 373, 380

Part IV Mathematical Text Index

Mathematical problem texts cited or edited in this volume are listed here. Museum numbers in bold represent a text edited in this volume, either in transliteration, translation or both. Note: Index entries represent Museum number — Primary publication.

A

AO 06456 — Thureau-Dangin 1922: no. 31, 128

Ashm 1923-410 — Robson 2004b: 22-23, 38, 43, 197, 395

B

BM 085211 — Robson 2014: oracc.museum.upenn.edu/obta/P412467/html, 93, 94, 96, 208, 209, 211, 226, 227, 256, 388

BM 085238 — Robson 2014: oracc.museum.upenn.edu/obta/P412466/html, 93, 94, 96, 208, 211, 226, 227, 230, 256, 388

H

HS 235 — Hilprecht 1906: pl. 21, 42, 43, 52, 57, 395

I

IM 57828 — Neugebauer and Sachs 1984: 247-48, 32, 168, 169, 338

IM 57846 — Neugebauer and Sachs 1984: 246, 169

M

M 10 — Sachs 1952: 152, 195–197, 224, 232–234, 246, 250, 339

M 7857 — Guichard 1997: 315, 32

MS 2830 — Friberg 2007: 159, 189–191, 222, 223, 225, 227, 340, 342

MS 3866 — Friberg 2007: 74, 76, 53, 57

MS 3974 — Friberg 2007: 85-87, 472-73, 53, 57, 256

N

N 3914 — Robson 2000: 027-028 no. 10, 231, 233, 339

N 3958 — Sachs 1947: 229, 129

Ni 18 — Proust 2007: pl. 1, 168, 169, 340

P

Plimpton 322 — Neugebauer and Sachs 1945: 38, 128

PTS 247 — Neugebauer and Sachs 1945: 18, 32, 55, 340, 341

U

UET 6/2 233 — Robson 1999: 253, 203, 216, 222, 225, 227, 341, 400, 404

UET 6/2 295 — Robson 1999: 250, 55, 195, 232, 342

UM 29-15-192 — Neugebauer and Sachs 1984: 251, 169

UM 29-15-481 — Neugebauer and Sachs 1945: 36, 168, 169

UM 55-21-076 — Neugebauer and Sachs 1984: 246, 168, 169

V

VAT 08521 — Neugebauer 1935-1937: II pl. 54, 179, 180, 183, 184, 189, 202, 222, 223, 253, 254, 343

VAT 08528 — Neugebauer 1935-1937: II pl. 56, 184

Y

YBC 04607 — Neugebauer and Sachs 1945: pl. 12, 26, 164–168, 230, 343

R. Middeke-Conlin, *The Making of a Scribe*, Why the Sciences of the Ancient World Matter 4, https://doi.org/10.1007/978-3-030-35951-5

YBC 04663 — Neugebauer and Sachs 1945: pl. 7, 201–204, 209, 212, 213, 215, 216, 221, 225, 226, 251, 255, 256, 345, 346
YBC 04666 — Neugebauer and Sachs 1945: pl. 9, 202, 216, 225, 346
YBC 04669 — Neugebauer 1935-1937: III, pl. 3, 184
YBC 04698 — Neugebauer 1935-1937: III, pl. 5, 124, 183, 184, 188–191, 202, 223, 225, 231, 232, 257, 346
YBC 05022 — Neugebauer and Sachs 1945: 132, 165
YBC 07164 — Neugebauer and Sachs 1945: pl. 10, 205–208, 226, 256, 347
YBC 07356 — Nemet-Nejat 1995: 256, 223
YBC 10529 — Neugebauer and Sachs 1945: 16, 196, 232

Subject Index

A

Abacus, 15, 17, 121, 125, 127–130, 134–138, 152, 229, 230, 234, 235, 241, 247, 252, 254, 351, 377, 378

Abī-sarē, 8

Abu-waqar, 145, 146, 152, 154, 173, 177, 178, 383

Accountability, 59, 60, 68–70, 77, 78, 80, 81, 142, 155–157, 349, 365

Accuracy, 140, 161, 162

Advanced education, 14, 16, 39, 40, 170, 184, 185, 233, 249, 254–257, 358, 370, 374, 378, 380, 383, 387–389

Aḫiya, 65, 186, 277, 385

Aḫūšunu, 75, 235, 290, 377, 434

Algorithm, 32, 55, 177, 185, 189, 222, 224, 227, 242, 249, 253–256, 342

Anzagar-Balamunamḫe, 84, 87, 89–92, 300, 303

Approximate reciprocals, 195, 224, 233, 250, 257

Approximate value, 6, 113, 174, 186, 247, 252

Approximations, 6, 17, 19, 20, 102, 103, 168, 171, 174, 195, 196, 224, 228–230, 232–234, 242, 244, 247, 250, 257, 288

Area and volume system, 23

Area lists, 41

Area system, 25, 135, 163

B

Babylon, 7, 8, 12, 66, 93, 103, 105, 131, 173, 186, 201, 204, 229, 260, 272, 277, 296, 297, 309, 311, 312, 320, 337, 360, 377–385, 437

Babylonia, 7, 10, 32, 34, 226, 287

Balamunamḫe, 84, 85, 88, 89, 355

Balanced accounts, 59, 62–64, 66, 68, 69, 73–75, 77–80, 82, 85, 87, 96, 124, 130, 151, 155, 156, 195, 238, 252, 261, 264, 270, 272, 282, 297, 303, 310, 312, 331, 339, 357, 362, 363, 441

Balance pan, 147–149

Bēlānum, 37, 38, 311

Bītum, 83

Brickage, 26, 236–238, 352

Brick typology, 165

Bridges, 27, 87, 95, 170

Bureau archives, 11, 59, 69, 80–84, 98

Bureau head, 60, 62, 71, 85–91, 94, 96, 97, 356, 367, 387

Bureau of irrigation and excavation, 24, 26, 57, 60, 63, 64, 75, 81, 82, 92, 94, 96, 98, 116, 117, 200, 201, 215, 219, 220, 225, 226, 228, 230, 244, 253, 256, 317, 330, 331, 334, 337, 341, 352, 358, 359, 368, 369, 372, 373, 380, 387, 388, 433, 434

C

Canal contractor, 60, 93–96, 317, 352, 380

Canal inspector, 98, 99, 369, 387

Capacity lists, 41

Capacity system, 5, 23, 28, 130, 131, 133, 147, 252

Capacity tables, 42, 46

Carrying mistakes, 126, 135

Carrying numbers, 128, 252, 381

Centesimal system, 30–32, 96, 99, 216–218, 226, 256, 341, 350, 359, 370

Certain value, 110, 161, 162, 170, 173, 174, 192, 225, 235, 241, 352

R. Middeke-Conlin, *The Making of a Scribe*, Why the Sciences of the Ancient World Matter 4, https://doi.org/10.1007/978-3-030-35951-5

Change rates, 139, 151–154, 156, 172–174, 177, 178, 184, 185, 224, 234, 236, 246, 249, 252–254, 256, 296, 324, 351, 365, 374, 379, 388, 429, 432, 434, 435, 437, 439
Classical Greece, 141
Classical Greek, 17, 18, 141, 155
Coefficient lists, 55, 256, 373, 387
Commentary, 5, 170, 177, 185, 221–224, 227, 249, 253, 255, 256
Composite list, 46, 49
Conceptual errors, 1, 18, 20, 177, 228, 245, 257
Conformity, 98, 109–111, 113, 114, 118, 153, 154, 173, 175, 177, 178, 185, 186, 199, 224, 225, 227, 228, 238, 241, 245, 250, 251, 253, 254, 352, 357
Conversion rates, 139, 153, 154, 173, 177, 178, 185, 224, 253–255, 296, 297, 376
Conveyor, 72, 85, 88–91, 96, 156, 254, 297, 317, 365, 375, 376
Counting device, 121, 130, 134, 136, 138, 213, 219, 226, 229, 230, 234, 240, 247, 251, 373, 381, 388
Craft archives, 65

D
Delivery agent, 84, 85, 87–92, 97, 98, 156, 356, 362, 364–366, 371, 372
Discrepancies, 1, 2, 4–6, 16–20, 59, 102, 103, 105, 106, 117, 121–128, 130–132, 134, 138, 139, 143, 147, 148, 155, 157, 165, 168, 169, 171, 173–175, 178, 181, 182, 186, 191, 200, 201, 213, 220, 224, 230, 234, 243, 245–250, 252, 257, 261, 267, 296, 300, 317, 350, 356, 357, 367, 373, 427, 430
Double entry bookkeeping, 11, 67, 68, 78, 79

E
Economization of practice, 177, 190, 221, 223, 227, 254
Elementary education, 14, 22, 34, 35, 40, 41, 46, 52, 101, 104, 111, 170, 185, 195, 197, 224, 225, 233, 250, 254, 256, 349, 358, 361, 370, 374, 376, 377, 380, 383, 385–387, 389
Emar, 13, 16
Epigraphic mistakes, 17, 124, 126, 168, 213, 324, 351, 383
Equivalencies, 65, 73, 101, 104, 106–111, 113, 114, 118, 123, 124, 134, 154, 173, 177, 178, 185–196, 198, 199, 202, 222, 224–227, 230, 242, 245, 247, 250, 251, 256, 267, 272, 277, 293, 351, 353, 354, 356, 357, 361, 362, 367, 368, 382, 383, 385, 386, 389, 407
Equivalency rate, 104, 106–109, 111, 113, 114, 118, 124, 154, 177, 185, 186, 189, 190, 194, 225, 227, 247, 250, 367, 377, 382, 407
Errors, 1–4, 6, 16–21, 24, 121, 123, 124, 134, 138–140, 157, 159, 160, 170, 174, 177, 191, 195–197, 224, 228–230, 233, 234, 240–242, 244–250, 254, 257, 350, 365, 376, 430
Error types, 18, 430
Estimated data, 66, 67
Estimation, 4, 6, 16, 20, 67, 94, 113, 118, 138, 141, 154, 172–175, 177, 178, 181, 185, 186, 194, 199, 200, 211, 224–226, 228–230, 245, 246, 248, 249, 251, 257, 282, 287, 320
Euphrates, 9, 330
Exactness, 162, 170, 172, 246
Experimental error, 18, 248

F
'False' errors, 19, 20, 233
Field inspector, 98, 377, 388
Formal tables, 63, 64, 79, 96

G
Ganba, 186–188, 191, 194, 347, 382
Gimillum, 62, 71, 72, 76, 81–91, 235, 254, 300, 355, 356, 362, 365, 366, 434
Gir$_3$ official, 84, 85, 88, 356, 374
Girsu, 22, 72
Grain accounts, 74, 75, 439
Grain harvest archive, 70, 81, 82, 97, 98, 105, 110, 117, 219, 221, 226, 227, 240, 244, 256, 350, 371, 372, 378, 434
Grain production archive, 26, 63, 64, 81–83, 97, 98, 221, 227, 236, 237, 244, 252, 256, 272, 312, 320, 349, 350, 377, 378, 388, 434
Grain rates, 107, 202, 221, 416, 417
Grain-rate texts, 200, 204, 215, 221
Grain shipment texts, 75, 76, 79, 161, 172, 245, 246, 252
Grain storage bureau, 3, 23, 24, 62, 70–72, 76, 78, 79, 81–85, 87–89, 96–98, 103, 145, 155–157, 159–162, 170–174, 234, 235, 237, 240, 248, 249, 252, 254–256, 297, 300, 302–305, 350, 355, 356, 361–367, 371, 372, 379, 383, 384, 434

Grain-wage texts, 200, 218
Granularity, 51, 152, 158, 159, 161, 163, 164, 168, 171, 172, 226, 230, 234, 235, 238, 240–242, 246, 247, 252, 253
Greek abaci, 129, 138
Gungunum, 7, 8, 27, 75, 146, 172, 186, 229, 251, 293, 302, 351, 408, 436

H
Hammu-rābi, 7, 8, 12, 13, 26, 63–66, 74, 75, 80, 82, 83, 93, 94, 96–98, 105, 116, 117, 131, 146, 152, 173, 177, 186, 209, 229, 236, 252, 260, 272, 296, 309, 311, 312, 320, 337, 349, 350, 360, 377–385, 407, 414–416, 437
Hellenistic Egypt, 142
Household, 10, 11, 24, 26, 60, 61, 67–73, 75, 77–83, 86, 87, 103, 109, 110, 114–117, 162, 220, 240, 254, 279, 284, 302, 349, 352, 354, 366, 370, 375, 386, 387, 418

I
I_3-ag_2-e, 139, 260
I_3-la_2-e, 139, 317
Iddin-Ištar, 65, 105, 311, 385
Iemṣium, 8
Ilī-ippalsam, 360
Ilīma-abī, 146, 152, 154, 173, 178, 319, 384
Ilšu-ibbišu, 25, 65, 109, 110, 186, 194, 241, 293, 354, 434
Immer-ilī, 26, 63, 201, 235, 327, 359, 370, 372, 373, 380, 387, 388, 434
In-kind rate, 103, 112, 187–191, 193, 196, 198, 199, 231, 232, 261, 263, 408, 416
In-silver rate, 111, 112, 187–192, 198, 261, 263, 408
Inspector, 60, 93–96, 98, 99, 369, 377, 387, 388
Interest calculation, 181, 184, 185, 202, 221, 222, 224, 253, 256, 374, 382
Interest rates, 177–180, 182–186, 222–224, 254–256, 297
Interest revenue, 179, 182, 253
Isin, 7, 11, 13, 73, 75, 240, 252, 254, 260, 262, 270, 271, 279, 291, 370, 375, 429, 435
Issu-nar-[…], 275, 386, 389
Itti-Sîn-milki, 24, 25, 27, 73, 75, 109, 113, 186, 195, 196, 241, 242, 247–250, 261, 267, 268, 284, 307, 349, 357, 358, 361, 389, 434

K
Kar(-bi), 76
Kārum, 66, 82, 110, 113, 187, 196, 379, 382–385
Kingdom of Larsa, 1–3, 6, 7, 10, 17, 21, 22, 41, 44, 53, 55, 57, 58, 75, 79, 81, 87, 93, 97, 101, 107, 111, 118, 138, 139, 141, 143, 148–150, 152, 171, 172, 204, 221, 225, 226, 229, 250, 254, 257, 276, 297, 302, 330, 334, 369, 370, 372, 374, 380, 389, 407, 413
Kudur-mabuk, 92, 307, 308, 368

L
Labor calculations, 109, 201, 220, 255, 370, 380
Labor contractor, 93
Labor costs, 221, 223, 226, 350
Labor rates, 101, 200, 208, 212–214, 221, 225, 226, 247, 253, 255, 256, 278, 369, 370, 417
Larsa, 1–3, 6–12, 17, 21–27, 29, 34–39, 41, 42, 44, 46–53, 55, 57–59, 61, 63–66, 69, 71, 74–76, 78, 79, 81, 83, 87–89, 93, 95, 97, 98, 101, 103, 105, 107, 109, 111, 115, 118, 124, 131, 138, 139, 141, 143, 145, 147–152, 155–157, 171, 172, 177, 178, 182, 184–186, 195–197, 204, 221, 224–226, 229, 237, 240, 249–255, 257, 259–261, 264, 265, 267, 269, 271, 272, 276–280, 282–285, 287, 289–297, 299, 300, 302–305, 307, 311, 312, 317, 324, 327, 330, 331, 334, 351–382, 384, 385, 387, 389, 391, 392, 395–399, 401, 405–407, 427–430, 435–437
Length lists, 41
Length system, 23, 25
Letters, 12, 13, 17, 84, 86
Lexical lists, 14, 144, 170, 172
Limited practical knowledge, 99, 190, 226
Limited practical Old Babylonian scribal training, 14, 257
Lists, 2, 6, 7, 14, 28–30, 35–37, 39–42, 44, 46, 49–52, 55, 58, 59, 62–64, 66–74, 77–80, 87, 101, 102, 105, 107, 116, 117, 139, 143–145, 162–170, 172, 173, 175, 177, 192, 196, 197, 220, 222, 230–232, 234, 237, 249, 250, 252–256, 261, 267, 272, 290–292, 310, 331, 349, 351–354, 358, 361, 363–367, 369–371,

373, 376–379, 381, 382, 386, 387, 389, 391, 398–400, 407, 413, 439
Lu-igisa, 60–62, 68–70, 77, 80, 96, 98, 235–238, 253, 291, 292, 352, 370, 373, 380, 387, 388, 433, 434

M

Margins of error, 247, 365
Mari, 11, 12, 17, 32, 149, 171, 263, 297, 317, 323
Mathematical practice, 15, 16, 20, 59, 99, 102, 121–124, 179, 185, 224, 227, 242, 253, 255, 286, 349
Mathematical processes, 2, 4, 12, 15, 16, 179, 222, 225, 350, 388
Measurement inconsistency, 155, 161, 162, 170, 172–174, 181, 182, 191, 192, 214, 226, 230, 234–236, 240, 245–249, 251, 252, 254, 255, 257, 356, 361, 363–366, 376, 430
Measurement standards, 144, 145, 150, 170, 353
Measurement uncertainty, 171, 174
Merchant, 10, 11, 24, 25, 59, 65, 66, 68, 71–77, 79–85, 87–89, 93, 94, 96, 99, 103, 105, 109–111, 113, 114, 118, 125, 140, 141, 145, 147, 149, 150, 172, 173, 177, 178, 187, 190, 195, 196, 224, 249–252, 254–256, 260, 263, 267, 272, 277, 293–295, 297, 298, 307, 310, 311, 317, 349, 351–354, 356, 357, 359–362, 368, 374, 379, 382–385, 438
Merchant archives, 11, 59, 80–83
Merchant community, 66, 76, 84, 110, 118, 187, 196, 250, 383
Merchant intermediaries, 24, 25, 65, 66, 71, 73–75, 77, 82, 83, 105, 109, 110, 113, 145, 173, 277, 310, 311, 352, 362, 383
Merchant overseer, 72, 82, 84, 85, 87–89, 105, 113, 145, 178, 195, 249, 254, 260, 267, 293, 294, 307, 310, 349, 351, 357, 361, 362, 368, 382, 383
Metrological lists, 3, 6, 21, 29, 30, 35, 41, 42, 44, 46, 51, 52, 57, 58, 101, 102, 116, 139, 143, 144, 162–170, 172, 173, 175, 177, 192, 196, 197, 230, 231, 237, 249, 250, 252–255, 272, 351, 354, 358, 361, 363–366, 370, 371, 376–379, 381, 382, 386, 387, 389, 391, 399
Metrological systems, 21–24, 27–29, 33, 34, 42, 46, 52, 58, 59, 147–150, 102, 107, 111, 121, 134, 135, 143, 144, 147–150, 162, 170, 180, 190, 234, 240, 255
Metrological tables, 5, 23, 25, 27, 33, 35–37, 39, 40, 42, 44, 46, 49, 50, 53, 55, 58, 101, 103, 116, 118, 149, 153, 162–164, 166, 168–171, 173, 192, 194–197, 199, 211, 224, 230, 235, 242, 249, 250, 354, 356, 357, 361, 367, 368, 370, 372–374, 377, 378, 380, 383, 385, 388
Microculture, 15, 16, 50, 57, 58, 143, 144, 169, 226, 254, 255, 257
Mistake, 1–4, 6, 15–21, 103, 105, 121, 123, 124, 126–129, 132, 134, 135, 137, 138, 157, 159, 160, 165, 168, 174, 196, 197, 201, 209, 211, 213, 219, 224, 229, 230, 240, 245–248, 252–254, 256, 257, 261, 267, 269, 272, 273, 275, 276, 281, 288, 290, 317, 320, 324, 331, 337, 348, 351, 364, 371, 377, 381, 400, 402, 427–432
Multiplication tables, 37, 39, 52, 53, 55, 57, 58, 109, 111, 114, 118, 152–154, 177, 186, 191, 195, 196, 199, 220, 221, 225, 231, 233, 256, 351, 354, 356, 368, 371–373, 376, 378

N

Nabi-Šamaš A, 64, 235, 359, 370, 373, 380, 434
Nabi-Šamaš B, 146, 152, 173, 177, 178, 184, 254, 300, 379
Namīram-šarur, 337, 380
Naplanum, 7, 8
Nippur, 7, 13, 21, 22, 29, 34–37, 39–42, 44, 46, 49–53, 55, 58, 95, 109, 114, 116, 118, 129, 144, 147, 149, 152, 168, 169, 171, 172, 190–194, 198, 199, 223, 237, 253, 255, 369, 380, 391–406
Non-regular numbers, 55, 103, 111, 195–197, 224, 225, 229, 231–233, 237, 246, 247, 250, 254, 257, 357, 358
Numeracy, 16, 17, 81, 84, 97, 139, 209, 249, 349
Numerical systems, 5, 21, 22, 28, 34, 44, 46, 50, 51, 55, 57, 58, 101, 107, 111, 143, 231, 233, 245, 254, 353
Numerical tables, 3, 21, 35–37, 39–41, 52–55, 57, 58, 101, 104, 109, 139, 152, 153,

173, 175, 185, 190–195, 198, 199, 221, 224, 225, 227, 230–232, 249, 250, 252, 254–256, 351, 358, 359, 364, 367, 368, 370, 371, 374, 376, 377, 379, 380, 382, 383, 385–389, 399
Numeric data, 10, 102, 118, 208, 350
Nūr-Adad, 7, 8, 73

O
Observational errors, 18, 20, 140, 228, 245, 257
Old Assyrian merchants, 150, 263
Ordinal numbers, 30, 34, 302, 376

P
Partial-SPVN, 33, 114–117, 119, 130, 131, 134–136, 138, 205, 207, 209, 254, 285, 355, 388
Personal household archives, 11, 69, 77–81, 83, 162, 381
Precision, 140, 161, 162
Prisms, 27, 35–37, 39, 40, 51, 52, 211, 394, 397–399, 406
Production rates, 371
Professional education, 14, 40, 96, 99, 226, 250, 255, 256, 352, 356, 358, 368, 370–374, 376–380, 385–389
Project statement, 200, 204, 208, 221, 222, 227, 244, 255, 350, 369
Prosaic format, 62, 97, 98, 312, 378
Prosaic texts, 62, 64, 74, 260

R
Reciprocal extraction, 195, 232, 243
Reciprocal tables, 52, 53, 55, 57, 58, 108, 109, 111, 114, 118, 186, 190, 191, 193–195, 198, 199, 233, 250, 356, 373, 387, 399
Remeasurement, 78, 139, 143, 151, 154–157, 172–174, 177, 182, 246, 247, 257, 297, 324, 374, 376
Responsibility, 59, 60, 70, 72, 75, 80, 81, 84, 96, 142, 156, 304
Revenue calculations, 173, 178, 182, 183, 224, 226, 380, 382, 388, 394
Rīm-Sîn, 7, 8, 10, 24–27, 34, 37, 38, 60, 63–66, 70–76, 80, 82, 83, 85, 87–97, 99, 103, 105, 109–111, 115, 116, 124, 126, 146, 151, 155, 172, 181, 186, 195, 199, 200, 212, 215, 218, 240, 242, 252, 261, 264, 265, 267, 269, 271, 272, 278–280, 282, 283, 285, 289, 290, 299, 302–305, 307, 317, 324, 327, 330, 331, 334, 350, 353–384, 408–414, 416, 436, 437
Rīm-Sîn II, 7, 8
Rīm-Sîn-rappašunu, 95, 200, 330–332, 350, 369
Rounding numbers, 1–4, 16, 18, 22, 63, 102, 195, 211, 229, 230, 249, 253, 254, 257
Roundoff error, 224, 234, 242, 250

S
Šadādum, 139
Sāmium, 7, 8
Sa$_{10}$, 186–188, 264, 265, 272, 285, 293, 294, 306, 308, 347
Sag-bi$_2$ la$_2$, 142, 151, 152, 172, 297, 324, 327
Sag il$_2$-la-bi, 140, 142, 151, 152, 172, 294, 351
Šamaš-aššu-aplu, 24, 63, 75, 334, 337, 358
Sample measurement, 139, 142, 143, 151, 154, 156, 157, 172, 173, 178, 184, 185, 234, 246, 249, 251, 252, 256, 296, 297, 351, 365, 379
Samsu-iluna, 7, 8, 65, 66, 74, 82, 93, 94, 103, 186, 208, 209, 277, 379–383, 385, 415
Sanāqum, 142, 361
Šanûm, 155
Šatammu officials, 65, 110, 293, 296, 417
Scribal competence, 161
Scribal curriculum, 2, 3, 6, 11, 14, 17, 18, 22, 37, 39, 41, 53, 57, 102, 110, 114, 152, 154, 162, 163, 177, 179, 184, 185, 227–229, 231, 232, 250, 253, 257, 378, 388
Scribe A, 27, 75, 146, 186, 235, 293, 351, 433
Scribe B, 73, 353
Scribe C, 71, 109, 116, 284, 360
Scribe D, 71, 115, 284, 354
Scribe E, 76, 84, 85, 91, 156, 158–161, 350, 362
Scribe F, 71, 83–85, 302, 366
Scribe G, 24, 75, 84, 367
Scribe H, 75, 235, 368, 434
Scribe I, 26, 27, 63, 64, 330, 331, 350, 359, 368, 373, 380, 387, 388
Scribe J, 239, 279, 370, 434
Scribe K, 34, 289, 371
Scribe L, 97, 105, 110, 280, 282, 371, 372
Scribe M, 97, 239, 240, 278, 372, 434
Scribe N, 34, 71, 265, 376, 434
Scribe O, 97, 98, 236, 237, 272, 273, 349, 377, 378, 434
Scribe P, 26, 63, 64, 98, 131, 239, 312, 320, 349, 377, 378, 434
Scribe Q, 26, 63, 116, 337, 359, 370, 373, 380, 387, 388
Scribe R, 63, 370, 373, 380, 386, 388, 434
Scribe S, 276, 387
Scribe T, 98, 115, 286, 377, 388

Šēp-Sîn A, 186, 235, 264, 367, 434
Šēp-Sîn B, 65, 74, 146, 186, 260, 381
Ṣillī-Šamaš, 76, 84, 85, 87–90, 92, 145, 146, 158–161, 172, 174, 177, 178, 263, 301, 303, 304, 362, 364, 365
Sexagesimal place value notation, 5, 22, 32, 42, 44, 52, 101, 107, 114–116, 131, 139, 204, 208, 229, 237
Silver accounts, 74–76, 88, 188, 438, 439
Silver economy, 66, 74, 77
Silver texts, 78, 79, 82, 362
Sîn-apil-Urim, 37, 38
Sîn-errēš, 76, 84, 85, 89, 92, 158–160, 295, 300, 306, 366
Single transaction, 59, 65, 70, 72, 73, 77, 79, 80, 438
Sîn-iddinam, 7, 8, 25, 64, 65, 75, 90–92, 109, 151, 172, 177, 178, 186, 235, 254, 284, 293, 299, 303, 324, 326, 353, 354, 373, 374, 376, 388, 408, 436
Sîn-iqīšam, 8, 379
Sîn-irībam, 8, 303
Sîn-māgir, 76, 84, 85, 87, 88, 90–92, 158–161, 236, 264, 266, 305, 306, 355, 364, 434
Sîn-muštāl, 74, 81, 82, 105, 186, 310, 382, 383
Sîn-rāmā, 72, 75, 156, 181, 182, 239, 240, 254, 269–271, 374–376, 388, 434
Šîqum, 171
Specialized knowledge, 99, 359, 373, 388
Standard conversions, 153, 155, 172, 174, 178, 185, 227, 228, 297, 298, 365, 382–384
Standardization, 101, 142
Statistical data, 18
Šulpae-nāṣir, 65, 272, 274, 360
Sūmû-el, 7, 62, 69, 92, 93, 99, 237, 259, 291, 352, 436
Sūtu, 11, 66, 72, 74, 76, 80, 82, 105, 277, 311
Standard vessel, 23, 144–146, 150, 152–156, 172, 178, 184, 252, 260, 295, 297, 298, 304, 351
Syrian weights, 148, 150, 171
Systematic errors, 229, 233, 245, 248, 257
System G, 30, 31, 132
System S, 5, 30–32, 105, 106, 133, 150, 217, 218, 239, 344, 359, 370, 377, 383

T

Tables of cubed roots, 39, 52, 53
Tables of square roots, 39, 52, 53, 55
Tables of squares, 39, 52, 53, 55, 57
Tablet typology, 11, 35
Tabular, 38–40, 59, 62–64, 74, 75, 77–79, 92, 93, 96, 99, 131, 132, 151, 189, 201, 208, 212, 215, 221–223, 229, 252, 260, 312, 317, 320, 324, 327, 330, 331, 334, 350, 351, 358, 359, 370, 373, 374, 378, 380, 400, 401, 404, 405, 439
Tabular array, 96, 317, 334, 358, 374
Tabular format, 40, 62, 78, 79, 92, 93, 99, 215, 222, 312, 331, 350, 370, 373, 378, 380
Tabular layout, 64, 74, 131, 221–223
Tabular lists, 63, 64, 74, 96, 252, 351, 359, 439
Tabular texts, 63, 96, 132, 189, 201, 212, 229, 260, 320, 327
Tacit knowledge, 81, 98, 101, 102, 117, 118, 244, 388
Târum, 153, 297
Tax rates, 177, 183, 184, 224, 254, 297, 376
Tax revenue, 181–184, 226, 253, 388
Temple administration, 83, 375
Temple of Šamaš, 85, 86, 88, 301
Temple of Inanna, 309, 354, 356
Temple of Nanna, 98, 131, 307, 308, 315, 316, 322, 323, 378
Textual analysis, 10, 11, 13
Tigris, 9, 274, 330, 331
Trailing parts algorithm, 55, 342
Translate, 30–32, 55, 66, 84, 153, 187, 281, 282, 285, 296, 309, 317, 320, 327, 348
Transparency, 4, 5, 30, 62, 101–103, 105, 106, 110, 116–118, 122, 174, 185, 218, 365
True value, 19, 20, 140, 161, 162, 245, 246
Truncation, 6, 124, 134, 139, 152, 158–160, 162, 169–171, 174, 192, 213, 214, 224, 226, 229, 230, 232, 234–236, 238, 240, 246, 247, 249, 251, 257, 356, 359, 373, 374, 387, 427–430, 432–439
Trust, 141, 142, 155, 156
Type I tablets, 35–37, 39–41, 51–53, 57
Type II tablets, 36, 37, 39, 42, 52, 53
Type III tablets, 37–39, 52, 53, 57
Type IV tablets, 37–41, 169

U

Ubār-Šamaš, 24, 25, 71, 72, 75, 84, 85, 87–91, 109, 260, 262, 263, 357, 361, 362, 365, 367, 374
Umma, 1, 24, 26, 69, 85, 98, 114–116, 130, 289, 290, 304, 306, 394
Ur, 4, 7, 12, 13, 21, 22, 26, 34–36, 38–42, 46–53, 58, 63, 64, 66, 69, 73, 74, 82, 87, 98, 105, 109, 110, 131, 144, 145, 147,

149, 152, 171, 172, 203, 229, 252, 254, 255, 263, 292, 295, 302, 308, 310, 312, 317, 320, 334, 353, 354, 356, 358, 362, 378, 383, 384, 391, 398–401, 404, 405, 430, 435
Ur III (period), 7, 11, 14, 23, 33, 67, 69, 71, 72, 74–76, 79, 80, 86, 114–116, 129–131, 142, 145, 150, 178, 185, 188, 199, 263
Uruk, 7, 9, 61, 86, 179, 184, 265, 270, 343, 375

V
Value estimation, 173, 177
Volume calculations, 200–202, 205, 208, 212, 213, 216, 226, 254, 256

W
Wage calculations, 217–220, 230, 245, 281, 359, 372, 386, 389
Wage rate, 95, 97, 105, 107, 108, 110, 114, 117, 127, 177, 200, 203, 204, 212, 213, 215–222, 225–227, 250, 251, 253, 255, 280, 331, 359, 367, 369–372, 386, 407, 424, 425
Warad-Sîn, 7, 8, 62, 66, 76, 82–85, 88, 89, 110, 195, 263, 285, 297, 300, 301, 306, 307, 353–357, 360, 364, 365, 373–375, 379, 383, 384, 409, 417
Weight lists, 41, 353
Weight system, 23, 24, 28, 135, 163, 164, 230, 351
Work assignment, 95, 200, 202, 203, 205, 208, 212, 213, 216, 221, 222, 292, 294, 322, 323, 337, 338, 341, 345, 346, 380

Y
Yield rates, 256, 320, 378

Z
Zabāia, 7, 8
Zarbilum, 24, 25, 27, 73, 75, 109, 113, 195, 196, 249, 250, 254, 263, 264, 267, 307, 308, 357, 428, 435
Zinnu, 270, 271, 381